HELLO, 4K LCD!
Asus 31.5-inch panel boasts four times the resolution of 1080p PG. 76

AC ROUTERS ARRIVE
Seven 802.11ac Wi-Fi routers demo the new spec's capabilities PG. 34

ASROCK M8
Build your own micro-tower with this BMW-designed bare-bones kit PG. 74

MAXIMUM PC

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SUPERCHARGE YOUR PC

MOVE YOUR OS TO AN SSD AND REAP AMAZING REWARDS—WE SHOW YOU HOW!
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GEFORCE GTX
SAMSUNG

BUILD IT:
AMD's R9 290X in a small form factor PC! PG. 58

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THE NEWS

The Rise and Fall of OCZ

Toshiba buys OCZ's SSD division, PSUs up in the air

OCZ'S TROUBLES aren't new to anyone who has followed the company of late, but the winding road the company has taken to get there is surprising.

The company originally made its bones in 2002, selling overclocked RAM to enthusiasts and gamers. But having its cart hitched to the feast-or-famine RAM market led the company to soon diversify its product lineup with USB flash drives, flash memory, and even mice, keyboards, and CPU coolers.

Offering its own products wasn't enough, though. In 2006, the company went public on the London stock exchange. With its war chest bursting from the IPO, OCZ went on a purchasing binge to expand its holdings.

Starting the following year, OCZ purchased small-but-respected power supply maker PC Power and Cooling, and began selling those units alongside its own brand of PSUs. At the same time, mergers and acquisitions of boutique PC makers was in vogue, with Dell buying Alienware and HP buying Voodoo PC, thus OCZ laid claim to small custom-PC maker Hypersonic PC. But that marriage didn't last long. The bottom fell out of the economy in 2008, and OCZ shut down Hypersonic PC just two years later.

The Hypersonic failure didn't matter, though. OCZ also started making SSDs in 2008, and by the time Hypersonic PC was shutting its doors, OCZ had firmly established itself as a leading brand in the consumer and enthusiast sectors. OCZ's early success there gave it enough independence to even quit what it was most known for: RAM. And that's not the only thing that would get voted off the island. The company's flirtation with CPU coolers, mice, and keyboards also came to an end.

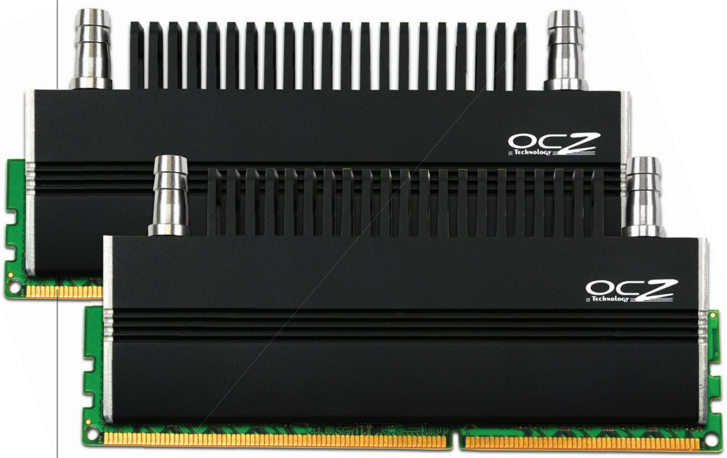
By the end of the decade, it was clear that OCZ's future was tied to SSDs. But it needed something to differentiate itself from other SSD makers who were buying their controller chips from a small handful of companies. So in 2011, OCZ purchased one of the chip makers, named Indilinx, and bolstered this purchase with intellectual property acquisitions, including PLX's Oxford Semiconductor and SANRAD.

But even with exclusive access to Indilinx's controllers and IP, it was no easy battle going toe-to-toe with huge companies like Samsung and Intel. Obtaining reliable low-cost supplies of NAND was a constant challenge, and by 2012, the company's problems had started to bubble over. It had to restate earnings going back to 2008, and it saw the company's founder and CEO, Ryan Petersen, get the boot. Last year, Hercules Technology Growth Capital loaned the company $30 million, but with a painful 15 percent interest rate. With OCZ's assets as the primary collateral, and the company unable to pay off the vigorish debt, Hercules took control of OCZ, and the latter filed for Chapter 11 bankruptcy protection.

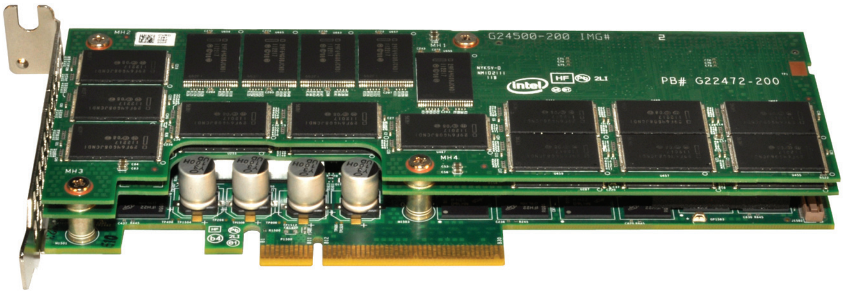
Laptop and storage manufacturer Toshiba has since agreed to purchase the company's storage-related assets and IP for $35 million. At this point, OCZ officials say warranties and support will be honored as part of the acquisition. Company officials also say the PSU division is not part of the deal with Toshiba. They are exploring what to do with PSUs, which still includes the PC Power and Cooling and ModXStream lines.

Toshiba and OCZ say more information will be known once their transaction has gone through, and have declined to provide further information at this time.

–Gordon Mah Ung



OCZ got its start selling enthusiast RAM, such as these liquid-cooled modules.



Intel Roadmap Shows 2TB 2.5-inch SSD

If you have a solid-state drive and are considering an upgrade to 250GB or 500GB, Intel is apparently way ahead of you. In December, tech site Myce.com obtained some legit-looking presentation slides for Intel SSDs indicating that the chip maker plans to release 2TB and 1.6TB drives in Q2 of this year. According to these slides, there will be two tiers—the P3500 series and the P3700 series. Both will have 2.5-inch and PCI Express variants. These would be MLC drives, too, with the P3700 series using HET, or High Endurance Technology, memory. The PCIe version should look like the one pictured here (once the shroud is removed). **–PL**

Microsoft Fights Huge Botnet

In December, Microsoft's Digital Crimes Unit attempted to take down a search-fraud botnet that was reportedly pulling in $2.7 million a month, according to tech site Ars Technica. This network is estimated to be using 2 million computers around the world to generate fake clicks on ad banners. With each click, the ad owner pays the site that's hosting the ad, so the costs can spiral quickly. Europol raided the locations that corresponded to the IP addresses of many of these computers. Unfortunately, the network is decentralized, so it was back up and running eventually, but Microsoft intends to monitor Internet traffic patterns caused by the shutdown to identify the botnet's co-conspirators. **–TM**

Dell Unveils Its 4K Monitors

With the explosion in screen resolutions occurring on smartphones, tablets, and even some laptops, desktop folks might have been feeling a little neglected lately. In December, Dell came to the rescue with no fewer than three 4K monitors, which have four times the resolution of 1080p. We've seen 32-inch 4K panels before, but Dell also spotlighted a 24-inch and 28-inch model, as well. The smallest one has an MSRP of $1,400, and the middle size, to arrive later on, will cost "under $1,000." As to why the middle one would be cheaper, we surmise that it will have "mainstream consumer" specs, while the other two are geared toward professional photographers and videographers. **–TM**

Tom Halfhill
Fast Forward

MORE MOORE'S LAW ANXIETY

WILL THE hand-wringing over Moore's Law never stop? Intel's announcement that its next-generation 14nm process will be delayed three months triggered yet another round of fretting over the fate of this widely misunderstood "law."

Much of the panic is because Intel's "tick-tock" strategy has indeed operated like clockwork, chiming a smaller geometry every two years. Slippage is common at other companies, but not at Intel. So when the world's largest semiconductor vendor stops the clock for three months, hearts begin palpitating.

Especially when Intel admits that disappointing yields prompted the delay. The factory's initial 14nm wafers have more defects than expected, ruining too much of each batch. If a certain percentage aren't usable, Intel can't earn the profits needed to pay for the factory.

But worry not—Moore's Law isn't dead yet. First, remember that it's merely an observation, not a scientific principle. In 1965, Gordon Moore observed that affordable integrated circuits were growing about twice as dense every 12 months. In 1975, slower progress persuaded him to lengthen the period to 24 months. (The oft-quoted 18-month cycle was someone else's idea.) So, the law isn't carved in stone, much less in silicon.

Besides, the industry hasn't kept pace for years. The law predicts that an affordable chip in 2014 should integrate nearly 38 billion components. (Moore counted resistors and capacitors, not just transistors.) The densest microprocessors today have more than 5 billion transistors, and the densest memory chips have 4 billion transistors and about 8 billion total components. The curve is definitely flattening, but it's still a long way from flat.

Intel's three-month blip is a reminder that process technology is becoming fiendishly complex, even for the world's best engineers. If future delays stretch into a whole year, we'll know we have crossed the watershed.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

Thomas
McDonald
**Game
Theory**

SPIES IN AZEROTH

SO, THE UNITED States has agents risking life and limb by braving the dangerous, topsy-turvy world of… massively multiplayer online games. Because if the government isn't free to pay their agents to spy on your crafting business in Azeroth, *the terrorists win!*

That's right: The NSA and other agencies are spying on World of Warcraft and Second Life players (and perhaps others) because something something *terrorists*! Bad men may use chat features to plan their next attacks. Because high-bandwidth, public, subscription-based entertainment software full of people hitting each other with swords is just the kind of thing that terrorists think of when they go looking for secure, discreet communication networks.

Isn't it bad enough that people have lives of such lonely desperation that they maintain Second Life accounts? Do we need to pile on the indignity by spying on their sad fumblings for human interaction?

My first reaction to this story was outrage. The rise of the surveillance state is one of the most disturbing things of my lifetime. Government stooges with poor reading skills apparently remembered dozing through *1984* in high school and mistook it for a how-to manual. I was always certain the American dystopia would follow the pattern of *Brave New World*, with a medicated population distracted by constant entertainment and meaningless sex, rather than *1984*, with a crude and thug-like state crushing citizens under its jackboot.

Never did I imagine that we'd get both, but then 16 years of Bushbama will do strange things to a nation.

Should we, as gamers, be angry that yet another part of American life is subject to the state's prying eyes? Or are these fools so far removed from reality that we've passed tragedy and moved into farce?

Given that the only spies they found were spies from other agencies—so many, in fact, that Second Life needed a group to keep FBI, CIA, and NSA from stumbling over each other—I'd say the latter.

Thomas L. McDonald is
Editor-at-Large of Games Magazine.

MSI Unveils 3K Gaming Laptop

Just before the end of the year, MSI announced what it said was the world's first laptop with a screen resolution of 2880x1620, which is 50 percent higher than 1080p. The GT60 20D-261US, with a launch MSRP of $2,200, sports an Intel Core i7-4700MQ, 16GB of RAM, and a GeForce GTX 780M (possibly the only mobile GPU that can smoothly handle 1620p). The default storage is a 128GB SSD and 1TB 7,200rpm HDD, and MSI also throws in a Blu-ray player, SD card reader, HDMI out, and a backlit keyboard designed by SteelSeries. **–PL**

Dell Joins Chromebook Party

Over the years, Dell has flirted with alternatives to Microsoft Windows, but it's never committed to anything on a large scale for a substantial amount of time. Meanwhile, HP, Lenovo, and Acer have owned the market for Chromebooks, those sub-$300 laptops that come with Google's Chrome OS instead of Windows. Now, Dell is joining that party with its recent announcement of the Chromebook 11. It is configured mostly like the others, with an 11.6-inch 1366x768 screen, Intel Celeron chip, 16GB of storage, HDMI out, and the option to have either 2GB or 4GB of RAM, and should be available by the time you read this. **–PL**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

+ **WINDOWS 7**
Microsoft changes its "End of Sale" date from October 2014 to "To be determined."

+ **ASUS**
Will sell all-black GTX 780 Ti GPU, let customer decide what color stickers (if any) to adhere to it.

+ **SAMSUNG**
Releases free update enabling "Rapid Mode" DRAM caching on its 840 Pro SSD. Thanks for the flash.

TRAGEDIES

− **AMD**
Radeon R9 290X are impossible to find at retail, and Bitcoin miners are driving up prices, too.

− **SAMSUNG**
Tries to silence a YouTuber named Ghostlyrich over fried Galaxy S4; suppression efforts go ultra-viral.

− **BATTLEFIELD 4**
We had this in here last month, and the bugs and crashing still aren't fixed. This is the last BF game we buy at launch.

Quinn
Norton
**Byte
Rights**

THINK YOU'RE INNOCENT?

WHAT DO THE Mafia and web forums have in common, besides colorful insults and threats, and tortured misuse of English? As of December, they are both subject to the RICO anti-racketeering laws, creating harsh, life-ruining penalties for even minor participants.

RICO is a federal law designed to get the bosses of organized crime who may not commit crimes themselves. But to do that, legislators had to make even somewhat loose association with anything perceived to be organized and criminal into a fairly easy-to-prove crime. Early on, RICO started creeping over our rights. It started being used against political activists, such as pro-life demonstrators, and expanded to where it's being used right now against Ecuadorian activists trying to get Chevron to clean up a toxic spill the company has already been convicted of. But it dates from the 1970s, a time when to make something happen you really had to organize things. Now you can put up a wiki, or a forum, or a tracker, go to bed, and wake up to a new criminal business, political movement, or vast collection of *My Little Pony* trivia by morning.

David Ray Camez, an Arizona teenager who was getting into carding and fake IDs when he got collared buying a fake driver's license from a Secret Service agent, was convicted again in December under RICO as a racketeer for using the website Carder.su. Under this interpretation, Americans who set up or use websites that facilitate illegal activity could be found guilty of every crime on that website. Along with the theory that every Terms of Service violation is a potential CFAA felony, everyone who uses a computer can go to jail as a felon. Like the world's worst lottery, all they have to do is pick you for guilt. Good luck, Citizen!

Quinn Norton writes about copyright for Wired News and other publications.

NSA and GCHQ Infiltrate World of Warcraft

UK newspaper *The Guardian* revealed in December that the NSA and GCHQ, its British counterpart, had been spying on the players of Blizzard's MMO World of Warcraft, possibly for several years, to the point of wholesale chat logging and even approaching some players in-game to become informants for them. The two spy agencies apparently feared that terrorists would use games like WoW and Second Life to secretly share intelligence and funds. The NSA in particular was interested in monitoring headsets and webcams to create a biometric database of users.

By law, the NSA is not allowed to spy on American citizens, but it is very difficult to determine which country a given online game user hails from, which adds serious legal implications. The paper quoted the GCHQ as saying, "All GCHQ's work is carried out in accordance with a strict legal and policy framework which ensures that its activities are authorized, necessary, and proportionate, and there is rigorous oversight." The NSA, meanwhile, would not comment on the story, nor would the executives of Linden Lab, which runs Second Life. A spokesman for Blizzard told the paper, "We are unaware of any surveillance taking place. If it was, it would have been done without our knowledge or permission." The NSA also reported that it had figured out how to intercept the communications between the users of Xbox Live, which has more than 45 million registered accounts.

The documents indicate that the agencies were unable to gather intel directly related to terrorist activity. **–TM**

WORLD
WARCRAFT
WRATH of the LICH KING

Sonic Malware Uncovered

Tech site ExtremeTech recently reported an unusual method of malware delivery: the speakers and microphones on your computer. Security specialist Dragos Ruiu claims that his laboratory computers were being infected with malware via over-the-air transmission, even with wireless network devices enabled. He narrowed the problem down to the speakers themselves, which are capable of sending data at up to 20 bits per second. Fraunhofer FKIE researchers Michael Hanspach and Michael Goetz were able to replicate the scenario, but they noticed that the system requires line-of-sight and less than 20 meters between the origin and destination of the signal. **–TM**

Intel Demos 64-Bit Android Tablet

Although Apple's iPad Air can call itself the first 64-bit tablet, it's using an ARM chip that isn't compatible with the x86 instructions used by almost all desktop chips. But at an investor meeting in December, Intel unveiled an Android tablet powered by a 64-bit x86 chip using the new low-power "Silvermont" Atom core. Intel says that moving from ARM to Silvermont could improve performance by up to 40 percent in some applications, like Photoshop. Intel also announced that it plans to have a line of tablets ranging from $99 to more than $249, with a variety of low-power chips and screen sizes. **–PL**

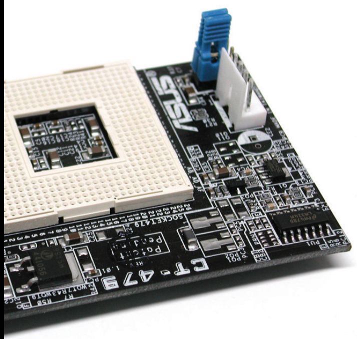
THE LIST

8 TECHNOLOGIES WE'RE PINING FOR

8

27-INCH, 2560X1600 144HZ IPS PANEL WITH G-SYNC

Sure, we could go as far as 4K, but that would be ridiculous. This would be a perfect addition to any gamer's rig.



7

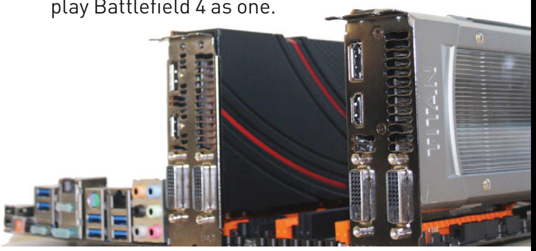
CPU SOCKET ADAPTERS

Long ago, these roamed the land but now they're dinosaurs: awesome extinct beasts that deserve a comeback.

6

MIX-AND-MATCH SLI AND CROSSFIRE

Why can't Nvidia and AMD play nice? Please just sing "Kumbaya" and play Battlefield 4 as one.



5

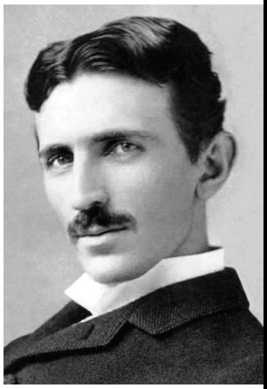
FIBER, FIBER EVERYWHERE

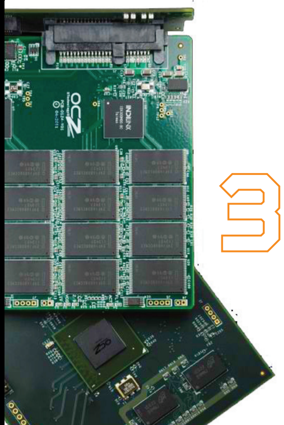
With 4K streaming on the horizon, who wouldn't want this?

4

WIRELESSLY CHARGING WORLD

Tesla dreamed it, so we should build it. Never plug in anything again and charge over the air!





3

4TB SSD

Hard drives should be a relic of a bygone era where people traded performance for space.

2

MINI CPU PHASE-CHANGE COOLER

These beasts resemble refrigerators but we'd pay good money for one the size of an H100i.

intel
Core™ i7

1

4GHZ INTEL CPU

Intel is focusing on die shrinks but we'd sacrifice a few degrees for a speed boost.

HEAD TO

BY GORDON MAH UNG

Call of Duty: Ghosts vs. Battlefield 4

Even the Nvidia fanboys can agree that AMD has a good part with the 290X. And even the most diehard AMDer will concede that Intel's CPUs are more efficient today. But there is *no way in hell* you'll ever conquer the divide between the Call of Duty and Battlefield camps. The gulf is simply too deep and wide, the loyalties too entrenched. Still, we think there's room for an objective assessment. So, this month we pit the latest titles in these two opposing franchises against each other to see which comes out on top, personal ties be damned.

Call of Duty: Ghosts has taken graphics up a notch with 4K textures, but its story line is somewhat silly.

ROUND 1

Single-player

It's no secret that Call of Duty has long been seen as an interactive movie shot from a script stolen from the reject pile at the Syfy channel. As bad as the plot might be, though, Infinity Ward has managed to turn even the most ridiculous story line into a fun-filled, action-packed romp. Yes, it has the deftness of Michael Bay with a train load of C4, but even haters can agree it's an entertaining ride. That couldn't be said of Battlefield 3, whose single-player mode was choppy and the storytelling boring. The narrative is greatly improved In Battlefield 4, but the script and some of the lines are still embarrassingly awful.

Winner:
CoD: Ghosts

ROUND 2

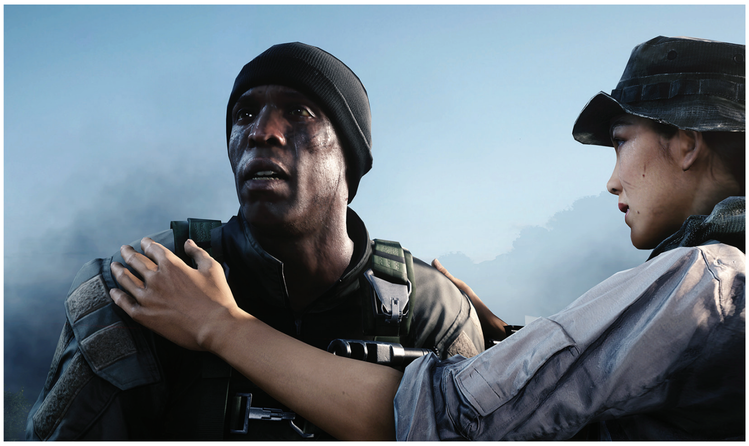
Multiplayer

Both games are first-person shooters, but beyond that, the two really don't resemble one another. Call of Duty: Ghosts has always been more of a twitch game and the multiplayer hasn't changed much. It's still mostly a two-dimensional affair (albeit with short periods of control of drones and choppers) but at its core, it's a man-on-man game. Battlefield 4, however, incorporates myriad aspects that make it the superior—and more complex—game of the two. With full-time land, sea, and air operations, a Commander dropping cruise missiles on your head, as well as massive mixed-environment maps, it's an intense and multifaceted 3D battlespace. Ghosts has its appeal in that it's far easier to pick up, but Battlefield 4 easily gets the nod for an outstanding multiplayer mode that forces you to think, not just shoot.

Winner:
Battlefield 4

HEAD

Battlefield 4 features beautiful character animations but some pretty awful dialogue.



ROUND 3

Eye Candy

We initially thought this category would easily go to Battlefield 4, with its destructible environments, impressive physics, and particle effects that make even burly systems cry. The single-player graphics are simply beautiful, and on multiplayer maps, players pull up lawn chairs to watch the buildings crumble or a dam break. Make no mistake: Battlefield 4 is a game that requires the latest-and-greatest gear to play at high frame rates at a high resolution. Call of Duty: Ghosts doesn't just lie down and quit, though. The days of running CoD on integrated graphics are long behind us and the 4K textures (50GB of game's worth) make CoD sheer beauty to behold on a 4K monitor. Hi-res textures aren't everything, though—the environment matters. So, we think Battlefield 4 has a slight edge thanks to its use of physics.

Winner:
Battlefield 4

ROUND 4

Realism

You don't combat-reload an empty Remington shotgun by putting one in the tube and racking it. No, the proper course is to open the action, drop a shell in the ejection port, and then smartly run the action forward. It's these little touches that make the weapons handling in Battlefield 4 a joy to experience. The developers of Call of Duty: Ghosts also spent some time modeling reloads correctly, including the magazine flip-out method that's popular today in the Tacticool scene, so weapons handling in both games is good. While we acknowledge that both games are very far from being tactical shooters (who carries a reusable parachute in their ruck full-time that can deploy on demand, or brings an SMG into space?), we have to give Battlefield 4 the nod for at least trying to introduce some ballistics modeling, but most people, like Francis, should just lighten up.

Winner:
Battlefield 4

ROUND 5

Bugs

They just don't make 'em like they used to, do they? Actually, that's not true at all. People just like to think that back in the day, when you installed a game by disc or cartridge and there was no Internet, that developers did their damnedest to wipe out all bugs before launch. That's not true or we wouldn't have memories of downloading esoteric patches via modem or waiting to get an updated floppy through the mail. Still, bugs today, like our games, seem grander and shinier than ever before. Call of Duty: Ghosts hasn't been bug-free—the developers have issued several updates to address stability and performance. But compared to the launch of Battlefield 4, it's been perfection. You know it's bad when people can't even *play* your game for an hour without a disconnect or crash. The pressure to squash the bugs has gotten so bad that publisher EA said it would halt all other development on the game and focus only on glitches until they were addressed. Ouch.

Winner:
CoD: Ghosts

And the Winner Is...

It was closer than we expected, and frankly, we had some disappointments with both titles, which seem to be running out of ideas, but we're giving the nod by a very narrow margin to **Battlefield 4**. This, of course, makes no difference to the fanboys and fangirls who will continue to skirmish on Internet forums and outside GameStop. ⏻

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Apple Ruining PCs
> Eyefinity Gaming
> CPU Upgrades

Three-Headed Fan Header

I have an Antec Two Hundred case with a Gigabyte GA-P67X-UD3-B3 mobo. The case came with two fans (one 120mm and one 140mm) that exhaust out the back and top. This case can handle three more 120mm fans, two in the front and one on the side panel. I would like to fill these with three fans pulling air into the case, creating positive air pressure. This may be a noob question, but how do I connect these three fans to a single fan header on the mobo? How does the *Maximum PC* crew connect multiple fans in a case? Is my only choice to buy a fan controller or can this be accomplished without one?

—Bob Edwards

THE DOCTOR RESPONDS: You could buy a fan controller ($20-$100), but we would probably just use a splitter cable or power distribution block. You can get two-way splitters for about $4 and three-way splitters for about $8. Just search for "fan splitter" or "power distribution block" on any tech-oriented store. You won't be able to control the three new fans independently, of course; you'd want a fan controller for that. And depending on the fans, you may not get enough power from the mobo header to run them all at full speed, so a fan controller is probably a better option. But if you don't mind running all three fans at the same speeds from the same header, you can do that for under $6. If you want all three to run at full speed, use a Molex-to-three-pin distribution block.

Apple Ruining Things

When I shut down my computer, I get a message saying, "Your PC ran into a problem and needs to restart. We're just collecting some error info, and then we'll restart for you." Then it runs a progress bar, but it hangs at 100 percent and never restarts. At the bottom of this error message it says, "Page_Fault_In_Nonpaged_Area (Apple Charger SYS)."

I've reinstalled Windows 7 and then Windows 8 but I still get this error message. So to shut down my computer I wait till it gets to 100 percent and I shut off the power. I turn it on in the morning and it acts as though nothing was wrong. I just can't shut it off without getting this error message.

—Loyal B. Gaskin

THE DOCTOR RESPONDS: That "Apple Charger.sys" is the giveaway. That's a file connected with the On/Off charger utility for your motherboard. Some Gigabyte mobos have powered USB 2.0 ports that can be used to charge a device (e.g., an iPad) even when the computer is off, and they're known to cause this error. Use the Add/Remove Programs utility to remove the offending utility and the errors should stop.

Internet Explorer 999.1

Most websites are misidentifying my browser. I have tried using Firefox, Chrome (my default browser), and IE, and all of them are being identified as unknown or IE 999.1. Most of the time I don't care, but there are a few sites that I cannot access at all. Yahoo is one of them; it defaults to an old mobile site despite me trying to manually redirect to its normal page. I'm guessing this problem is due to an add-on that I've installed at one time but I've since removed all add-ons and reinstalled all browsers (as much as I can with IE).

I've tried manually telling Chrome, IE, and Firefox to pretend to be another browser using console commands but that only works for that session and doesn't always work correctly. Can you help me figure out what I can do to fix this? The best guess I have is that something with my "user string" is bad but I'm not sure on how to fix this.

—Ken

THE DOCTOR RESPONDS: It does look like there's something spoofing your browser's user agent string. If it wasn't for the fact that this happens on every browser, and persists even after reinstalls, we'd assume it was a rogue add-on or extension. It still could be; now that most browsers sync your add-ons and extensions across platforms you could be uninstalling them, only to reinstall when you sign in to Firefox Sync or Chrome Sync.

There could be some rogue program on your computer spoofing your browser user agent across platforms, though the Doc has never heard of a program doing this. But it's more likely that you're connecting to the Internet via a VPN or proxy server which is inserting its own user agent string between you and the websites you're visiting. Try disconnecting from the VPN or proxy server (if you can) and see if the UA spoof persists. And you should run a full scan with Malwarebytes and your AV just to make sure you don't have a rogue program screwing with your user agent strings—or worse.

↘ submit your questions to: doctor@maximumpc.com

Running out of SSD Space

My current setup involves a 128GB OCZ Vertex 4, one of the old 10K RPM Western Digital VelociRaptors, and a 1TB NAS in RAID 1 where all of my music, pictures, movies, etc., are stored. I've long since run out of space on my SSD, thanks to Windows 7, WoW, Diablo, LoL, and Steam games, and have had to move my Steam repository to the VelociRaptor. My question is, what's my best approach to upgrade my SSD space? Should I look at getting a second Vertex 4 and doing a RAID 0 array, to get myself to a total of 256GB? Or should I look at getting one of the 256GB Samsung drives, and use that to boot from, and use the current Vertex to hold some games? Would I still get the SSD benefit if I have games that are on a separate SSD from the OS?

—Aaron Vandervort

THE DOCTOR RESPONDS: Yes, as long as the games are on an SSD you'll see faster load times. It doesn't matter whether the SSD is the same as your boot drive. The Doc would recommend the last option you mentioned: get a 256GB Samsung drive and keep your 128GB Vertex 4. You can either put the OS on the Samsung or move your games there, but there are no issues at all having one SSD for your OS and programs and one just for games. Several *Maximum PC* staffers do just that.

Can I Upgrade My CPU?

I currently have an AMD FX-6100 running on an MSI 990XA-GD55 (MS4670) motherboard with 12GB of Crucial Ballistic RAM. My question is, can I upgrade to the FX-8350 chip using this same motherboard? I'm pretty satisfied with this system and its performance for my wants and needs and just thought a little more chip might be in order.

—Mike Hussey

THE DOCTOR RESPONDS: This may seem like a basic question, but it's a good reminder to verify before you buy. Just because a CPU is socket-compatible doesn't mean it'll actually work on a specific board; Intel's Sandy Bridge-E X79 boards, for example, don't support Ivy Bridge-E CPUs. All motherboard manufacturers publish CPU compatibility charts on their support pages, and you should check your board's compatibility before you get that new CPU. Fortunately for you, Mike, MSI's support page for your motherboard indicates that it will support the FX-8350, provided you update the BIOS first.

Hardware-Independent Restore

Is there any easy way to upgrade my Core i5-2500K-based Windows 7 system to a Haswell motherboard and Core i7-4770K without totally reinstalling the OS and all of my programs? I'm keeping the same Samsung 840 boot SSD and WD 1GB Raptor data drive. My old Gigabyte P67 motherboard is acting up and I ordered a GA-Z87X-UD3H, Core i7, and RAM. Can I just install all the new motherboard drivers, etc., and get it going? I heard something about Acronis having a program that helps with this.

—David Winokur

THE DOCTOR RESPONDS: Yes, Acronis has this feature—they call it Universal Restore, but unfortunately it's not available on the free versions. You'd have to pony up $80 for True Image 2014 Premium. EaseUS ToDo Backup Workstation has a similar feature for $40. If you don't want to pony up the dough, though, the Doc's official recommendation is to suck it up and do a clean OS install.

Having covered our butts, though, if you don't mind taking a bit of a risk, you can try to do it manually. First, clone your boot disk to an external drive just in case something goes wrong. Next, go to Gigabyte's support page and download the drivers for your new motherboard. Extract them to an external USB drive, but don't install them.

Once that's done, shut off your computer and remove the data drive. Reboot into Safe Mode by holding F8 at startup, then remove the motherboard drivers in Device Manager—use the software download page for your P67 board as a checklist to make sure you've gotten everything. Then shut down again and swap in the new CPU and mobo. Fire up Windows; hopefully it boots. Install the new mobo drivers, restarting when necessary, and you should be good to go. This has usually worked for the Doc, but your mileage may vary, which is why the Doc's preferred solution is to do a clean Windows install.

High Res and Low Frame Buffer

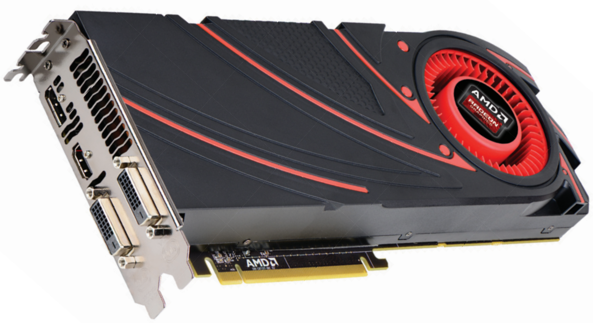
I'm using an XFX Double D Radeon HD 6870 1GB GDDR5 video card on three 24-inch monitors in Eyefinity mode, for a total resolution of 5040x1050. When playing some games, the picture will freeze, then go blank, then come back to normal. I tried dialing down settings in game but it still happens. I'm thinking of replacing the card with a new one or trying SLI or CrossFire with two cards. Any ideas on what cards or card I should pick up that will let me play in 5040x1050 on three 24-inch monitors on high settings?

—Joe Baio

THE DOCTOR RESPONDS: It's possible that there's something wrong with your GPU, PSU, or setup, but it's more likely your GPU just can't keep up. 5040x1050 is a lot of pixels to push through a midrange card with only 1GB of RAM, at least when gaming. That's probably your problem, rather than some error in the hardware. The fact that it happens irrespective of graphics settings is the clue. While it's tempting to get another HD 6870 to help, in a CrossFireX or SLI setup you're still limited to one card's worth of frame buffer, so it makes sense to upgrade to a faster single-GPU card with more RAM.

Based on our own testing of 4K gaming in the Lab, we know you need some serious firepower to play the latest games at maximum settings at über-high resolutions such as 5040x1050. In pure pixels, that's about 1.2 million pixels more than a 30-inch 2560x1600 panel but probably the most comparable and common resolution to look at if you're shopping by benchmark performance. Here's the Doc's general advice: If you spring $400 for a Radeon R9 290, you can hit about 30–40fps at max settings, and higher if you drop the AA down. In addition to having 4GB of GDDR5 frame buffer (four times more than your card), it's easily more than twice as fast as the Radeon HD 6870 in general, though with a TDP of 300W it will draw as much power as two 6870s.

If you move up to $500, that lands you the Nvidia GeForce GTX 780, which is a little faster than the R9 290 but is quieter and draws much less power. If you truly want top-of-the-line in a single card, $700 will get you the GTX 780 Ti. After that you're in the realm of dual-GPU options, which will draw even more power and run hotter. ⏻



The AMD R9 290 isn't cheap, but it's the cheapest single card we'd recommend for 5040x1050 gaming.

SUPERCHARGE YOUR PC WITH AN SSD!

IT'S HANDS-DOWN THE BEST UPGRADE MONEY CAN BUY

BY JOSH NOREM

Over the years, we've upgraded every nook and cranny of our rigs, from major parts like GPUs and CPUs, to minor things like trying different thermal pastes and swapping out case fans in an attempt to squeeze a few more degrees out of a rig's ambient air temperature. It's a bit OCD, we admit, but the point is, we've tried *everything*, and usually we're only able to see a small gain from our investment of time and elbow grease. That is not the case with SSDs, which deliver an eye-popping, profanity-inducing speed increase for relatively little cash outlay. If you've heard the hype about SSDs, we're here to tell you two things: First, the hype is real, and second, you need one in your system.

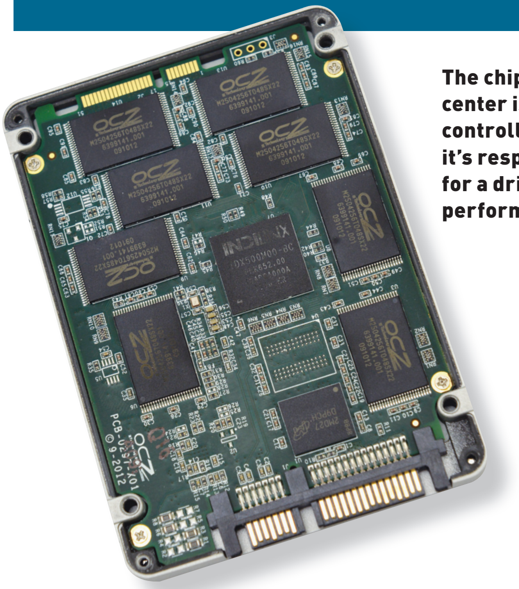
For the uninitiated, SSDs are solid-state drives, and they are like hard drives in that they store data, but instead of using slow, spinning platters, they are made from small slabs of quiet, fast memory. Adding an SSD to your rig can cut your boot time down to less than 10 seconds, and programs will open almost before you click the icon—they're that fast. In this feature, we'll tell you what you need to know to buy an SSD, how to upgrade, and how to take care of your new drive. An SSD will rock your rig's world, so let's jump right into it.

GEFORCE GTX
SAMSUNG
Solid State Drive
Seagate
Barracuda

After you've installed an SSD, it's perfectly natural to begin referring to it as "My Precious."

SSD BUYER'S GUIDE

WHAT TO LOOK FOR BEFORE PULLING THE TRIGGER



The chip in the center is the controller, and it's responsible for a drive's performance.

THE CONTROLLER

What truly differentiates every SSD is its controller, which is silicon with custom logic and firmware tailored by the manufacturer to meet specific performance and durability goals. Some manufacturers, like Samsung and OCZ, create their own controllers, while others, such as Seagate, Intel, Crucial, and Corsair (to name just a few), use a third-party controller along with their own custom firmware. We can't say that one approach is better than the other, but generally speaking, if a company's controller is designed in-house, it's not a stretch to imagine it would be able to more finely tune its firmware.

CAPACITY

SSDs are available in 128GB, 256GB, 512GB, and 1TB, for the most part, and as a rule, performance increases with capacity. The reason why is that an SSD's controller has to erase a block before it can write to it, so if it already has data on it, the operation takes longer than just writing to an empty block. So, larger-capacity drives give the SSD controller a lot more "empty" blocks to work with, thereby increasing overall performance. It's always nice to have some room to grow, too, so in general we recommend at least a 256GB drive, or a 512GB if you can swing it.

OVER-PROVISIONING

Over-provisioning is unique to SSDs, and is basically "missing capacity," for lack of a better phrase, that's used to improve drive performance and endurance. When you see a drive listed as 240GB or 480GB instead of 256GB or 512GB, that's because the extra space that is "missing" is being set aside. You cannot get this space back, nor can you ever access it. Instead, it's reserved so the SSD has a large block of relatively unused flash that it can use as a swap file, or for wear leveling. This is important since NAND flash has a finite number of program/erase cycles. In general, having an extra 16GB–32GB of NAND just for file management allows the SSD to better maintain its overall performance over time.

THE IMPORTANCE OF TRIM

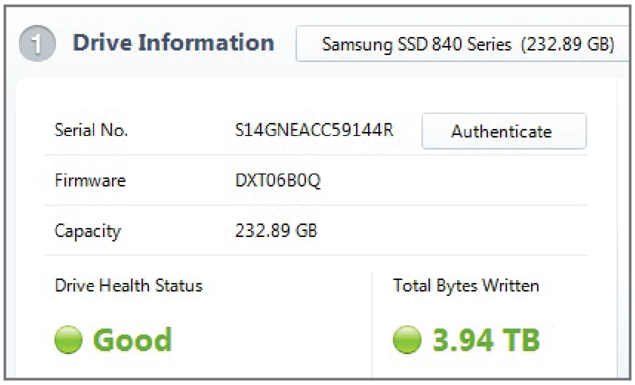
When you delete a file on an SSD, it doesn't really get deleted. Instead, the drive's controller marks the block as "garbage" and will delete it when it has time to do so, typically when the drive is sitting idle. If you have too many undeleted blocks of data on your drive, performance suffers, since each block has to be deleted before it can be written to. "Garbage collection" helps prevent this. It's supported on all SSDs natively that we are aware of, and runs on its own schedule. In addition, Windows will also periodically send the Trim command to the drive, which basically tells the drive to discard any deleted data. Windows 8 will let you manually Trim an SSD (right-click the drive and go to Properties > Tools > Optimize) but Windows 7 users just have to assume it's occurring. However, we'll tell you how to make sure it's working on page 30.

SOFTWARE

It's a little-known fact that some SSDs include extremely useful software that lets you monitor the drive's health and optimize it. Granted, there aren't a lot of times when you want to check in on your SSD, just like the hard drive before it. You just want it to work, basically, and not be bothered with the details. However, it can be useful from a performance perspective to be able to ensure the drive is operating in tip-top shape. Right now, the only SSDs with top-tier software are from Intel and Samsung, though Corsair and OCZ do have rudimentary software packages.

THE SATA 6Gb/s BOTTLENECK

For the past year or so, all the fastest SSDs have been bottlenecked by the SATA 6Gb/s interface, so when you see a drive hitting 520MB/s or so in read speeds, that means it's saturating the interface. You can get around this by running a few drives in RAID 0, or by using an SSD that caches data to your system's DRAM, but generally speaking, we're all waiting for the next-gen interface to arrive. That interface is named SATA Express, and it's due to arrive sometime in late 2014 or early 2015 with Intel's next-generation 9-series chipset. Until then, we all have to hold tight, but we don't recommend waiting to upgrade until then.



Samsung SSD 840 Series (232.89 GB)

Serial No. S14GNEACC59144R

Firmware DXT06B0Q

Capacity 232.89 GB

Drive Health Status: Good

Total Bytes Written: 3.94 TB

Samsung and Intel offer excellent drive-monitoring software.

BEFORE YOU UPGRADE

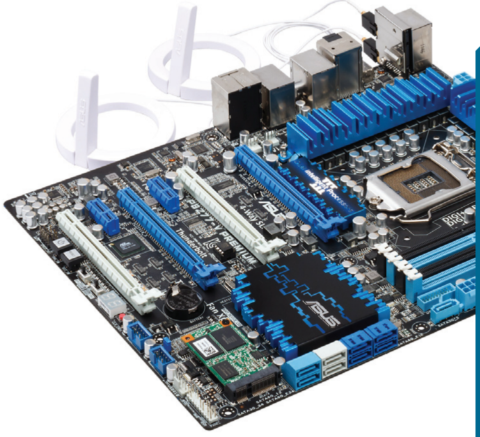
LIKE ANY MAJOR PC OVERHAUL, PLANNING AND PREPARATION IS REQUIRED

This is the first big question: Do you want to clone your existing OS installation to your new SSD (if you are even able to do so), or start fresh with a clean installation? There's no "right" answer here, and we'll walk you through both choices on the next pages, but here are some things to keep in mind. First, if your existing OS installation is larger than the SSD you have acquired, that's a problem for obvious reasons. Second, cloning an existing installation typically requires the use of third-party software (not a huge deal, but still something to consider), and if you have an OEM-built partition from Dell, HP, Toshiba, or other PC manufacturer, there are many steps to cloning the partition.

Due to the somewhat complex nature of cloning an OS to a new volume and having it be bootable, we recommend simply starting fresh and reinstalling your OS. Besides, since the ultimate goal of this whole operation is a performance boost, nothing is faster than a fresh install of Windows, and on a brand-new SSD it'll be astonishingly fast.

WHERE DOES IT GO IN YOUR PC?

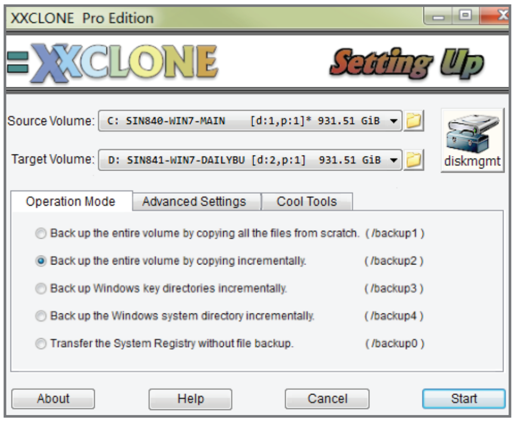
Since SSDs have no moving parts and don't emit any heat or noise, you can pretty much stick them anywhere inside your PC case and they'll be fine. We're not proud of it, but we have let a few dangle on the floor of our PC case in the past and nothing bad happened. To mount it properly though, you'll want to attach the drive to a 3.5-inch hard drive bay—in most newer cases there will be holes for 2.5-inch drives. In an older case, you are likely to need an adapter. Some SSDs even include 3.5-inch drive bay adapters, though it's not terribly common. Cooling is not a concern, as SSDs rarely get more than slightly warm to the touch, even after prolonged use.



SATA 6Gb/s ports are distinctly colored on your mobo.

BE SURE TO USE SATA 6Gb/s PORTS

You might not have paid attention to which drives were connected to which ports on your motherboard previously, but you will definitely need to do so if you want to extract maximum performance from your SSD. On modern Intel chipsets only specific ports are able to perform at SATA 6Gb/s speeds; typically they are a different color than the slower SATA 3Gb/s ports. There might also be two Marvell-based SATA 6Gb/s ports. We recommend you consult your manual to figure out which ones are the native Intel ports, and use those for best results. All the ports are SATA 6Gb/s on AMD's FX boards, so you can plug away without hesitation.



Source Volume: C: SIN840-WIN7-MAIN [d:1,p:1]* 931.51 GiB

Target Volume: D: SIN841-WIN7-DAILYBU [d:2,p:1] 931.51 GiB

○ Back up the entire volume by copying all the files from scratch. (/backup1)
● Back up the entire volume by copying incrementally. (/backup2)
○ Back up Windows key directories incrementally. (/backup3)
○ Back up the Windows system directory incrementally. (/backup4)
○ Transfer the System Registry without file backup. (/backup0)

Cloning your existing OS to a new SSD is the fastest way to get up and running, but it may not be easy, or possible.

AN SSD UPGRADE WILL BLOW YOUR MIND

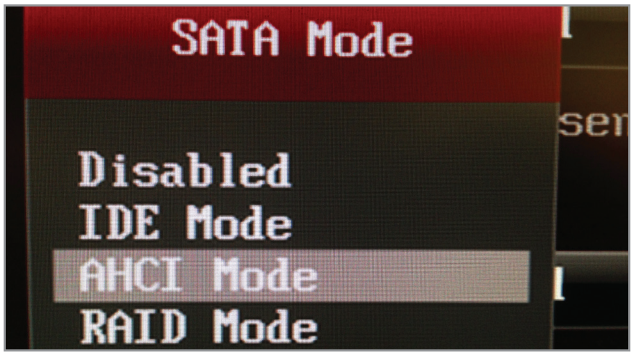
We've been upgrading PCs since just after the Proterozoic era, and in all that time we have only witnessed two truly quantum leaps in PC performance. The first was the leap from software to hardware rendering for 3D games, and the second was when we went from dial-up modems to broadband. Both of those "upgrades" made us say to ourselves, "Holy sh*t," while we stood there with our mouths agape. We got the same feeling the first time we booted a PC with an SSD. Granted, the first wave of 3.5-inch SSDs weren't the fastest, and they were outrageously priced, but the experience of seeing the Windows log-in screen within just a few seconds, and then seeing programs load almost instantly, brought tears of joy to our eyes. To give you some numbers, a typical 7,200rpm drive takes 10ms to find a file; an SSD takes .01ms. An SSD boots Windows in 10 seconds versus 60 seconds on a hard drive. You can install Windows 7 to an SSD in 10 minutes. Yes, it's ridiculously fast, and the first time you see an SSD in action, you will never, ever go back to a spinning hard drive for your OS.

PERFORM A FRESH INSTALL OF YOUR OS

A CLEAN INSTALL OF WINDOWS WILL GUARANTEE MAXIMUM PERFORMANCE

1 **DISCONNECT ALL OTHER DRIVES** Before you begin your OS install, disconnect all other drives and volumes from your system, leaving only your optical drive attached. This helps eliminate confusion and reduces the possibility of you accidentally formatting a drive that is full of data. Windows also freaks out sometimes during installation if there are other drives attached, and by freaks out we mean it acts really weird, and might prevent you from installing your OS to the SSD. We've Lab-verified this "weird" behavior, too, so always fly SSD commando when installing your OS. We also recommend leaving the door off your PC case during the installation, so you can easily reconnect everything once it's finished.

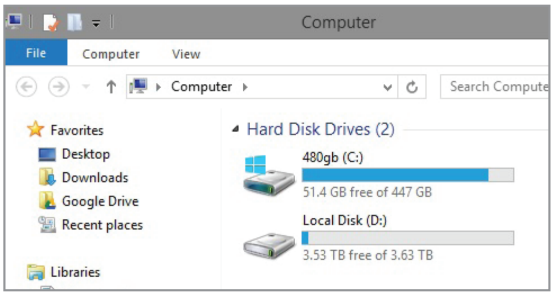
2 **SET YOUR BIOS TO AHCI** Once your SSD is installed in a drive bay (or stuffed somewhere inside the case) using the previously discussed methods, attach the SATA cable to a SATA 6Gb/s port, and a power cable to the PSU. With your SSD secure, power on the system and head into the BIOS by mashing the Delete key as soon as the system comes to life. Next, navigate to the section that gives you the option to change the behavior of the SATA controller. You are going to need to switch it from IDE to AHCI. You must do this before installing the OS to the SSD, as it becomes a bit difficult to do it after the fact.



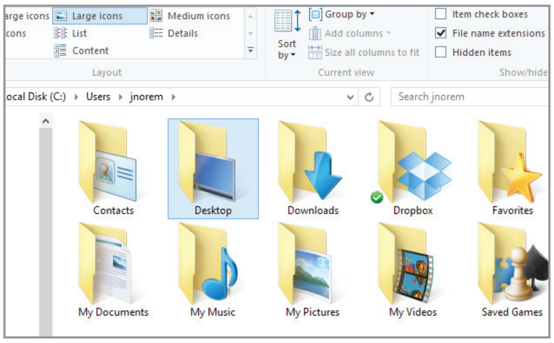
SATA Mode

Disabled
IDE Mode
AHCI Mode
RAID Mode

3 **INSTALL WINDOWS** With your SATA controller set to AHCI mode, reboot with just the SSD and optical drive attached. Next, hit F11 or F12 (consult your manual) to select your boot volume, and choose the drive with the Windows installation files on it (i.e., the optical drive). Just follow the prompts from there. Once installation is finished, reconnect your old hard drive and any other drives. When you're back in Windows you should have a fresh installation of Windows on your SSD and your old installation of Windows and all your data on your old hard drive. We'll show you how to properly navigate this new operating environment with respect to your "user" files on page 30.


Computer
File
Computer
View
Computer
Search Compute
Favorites
Desktop
Downloads
Google Drive
Recent places
Libraries
Hard Disk Drives (2)
480gb (C:)
51.4 GB free of 447 GB
Local Disk (D:)
3.53 TB free of 3.63 TB

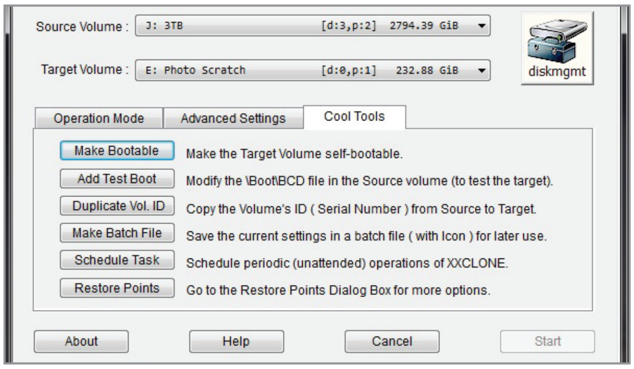
4 **PULL DESKTOP FILES OFF OLD DRIVE** One "issue" with Windows is that it puts all your data files (music, documents, etc.) into a folder named Users. This is great for a single, large drive, but can create problems in multi-drive systems like the one you have now—but more on that later. For now, you will want to go and grab your desktop files by opening your old drive and navigating to Drive/users/username/desktop. You can also grab your browser's bookmarks too, so hit up Google to find the location used by your specific browser. Install any drivers and programs you need but hold off on Steam for now.


arge icons
Large icons
Medium icons
cons
List
Details
Content
Layout
Sort by
Group by
Add columns
Size all columns to fit
Current view
Item check boxes
File name extensions
Hidden items
Show/hide
ocal Disk (C:)
Users
jnorem
Search jnorem
Contacts
Desktop
Downloads
Dropbox
Favorites
My Documents
My Music
My Pictures
My Videos
Saved Games

CLONE YOUR EXISTING OS INSTALLATION

IF YOU CAN SQUEEZE YOUR OLD OS ONTO YOUR NEW SSD, GO FOR IT

1 **MAKE TARGET DRIVE BOOTABLE** To begin, connect only the SSD and the cloning source drive to simplify the procedure. Once just the two drives are connected it's a simple matter of following the prompts provided by your program of choice, but to demonstrate, we'll be using a free program (for home users) named XXClone that we've used in the past with great success. (For a full range of cloning options, see our roundup on page 44). Once you fire up the program it'll scan your partitions and let you choose the cloning source and target. If you want to make the clone bootable you'll need to check a box under Cool Tools labeled "Make Bootable," which copies the MBR, BOOT.ini file and the boot sector to the target volume.



Source Volume : J: 3TB [d:3,p:2] 2794.39 GiB

Target Volume : E: Photo Scratch [d:0,p:1] 232.88 GiB

Make the Target Volume self-bootable.

Modify the \Boot\BCD file in the Source volume (to test the target).

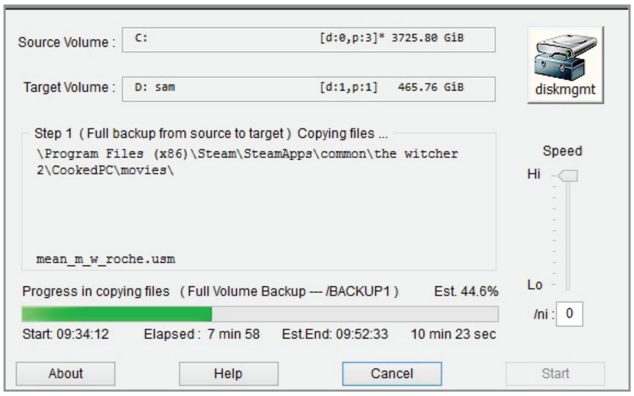
Copy the Volume's ID (Serial Number) from Source to Target.

Save the current settings in a batch file (with Icon) for later use.

Schedule periodic (unattended) operations of XXCLONE.

Go to the Restore Points Dialog Box for more options.

2 **CLONE YOUR DRIVE** Once you've confirmed your source and target, feel free to proceed with the cloning. It'll show you a "this is your last chance to stop" warning, so for the love of Pete, please make sure you have selected the proper target and source. The program we are using encourages users to use volume labels on the drives instead of just C:\ and D:\, so please, please, please use them. We have inadvertently wiped out entire OS installations with cloning mistakes, so please be cautious. The cloning operation will typically take about 15–30 minutes, so go grab some coffee.



Source Volume : C: [d:0,p:3]* 3725.80 GiB

Target Volume : D: sam [d:1,p:1] 465.76 GiB

Step 1 (Full backup from source to target) Copying files ...

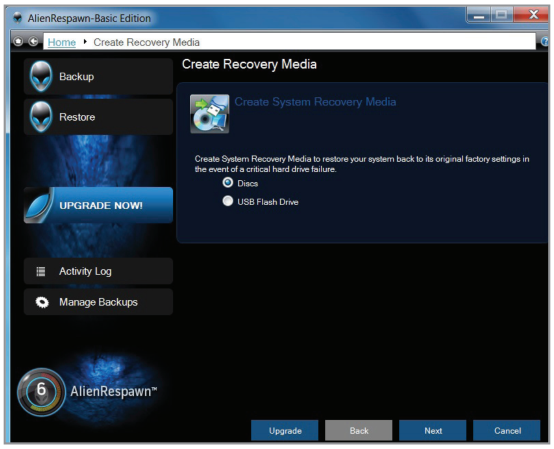
```
\Program Files (x86)\Steam\SteamApps\common\the witcher
2\CookedPC\movies\

mean_m_w_roche.usm
```

Progress in copying files (Full Volume Backup --- /BACKUP1) Est. 44.6%

Start: 09:34:12 Elapsed : 7 min 58 Est.End: 09:52:33 10 min 23 sec

/ni : 0

3 **OEM WORKAROUND** Folks who have a pre-built system may want to clone their factory-fresh OS installation, but a lot of times systems do not come with Windows on a disc. Also, some OEMs take measures to protect their factory restores and keep them hidden from view. Other systems allow you to see the recovery partition, but you can't clone it using software. Here's a workaround. Use the built-in Recovery software to create a recovery disc. Next, just replace your hard drive with the SSD and run the recovery program. It should restore your OS in factory condition with all drivers intact, and you'll be good to go.



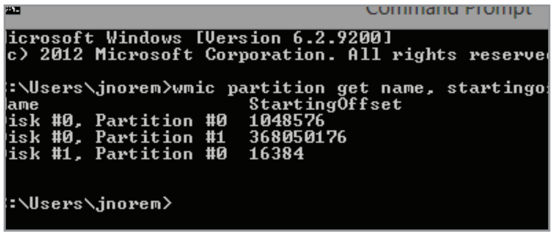
Create Recovery Media

Create System Recovery Media

Create System Recovery Media to restore your system back to its original factory settings in the event of a critical hard drive failure.

● Discs
○ USB Flash Drive

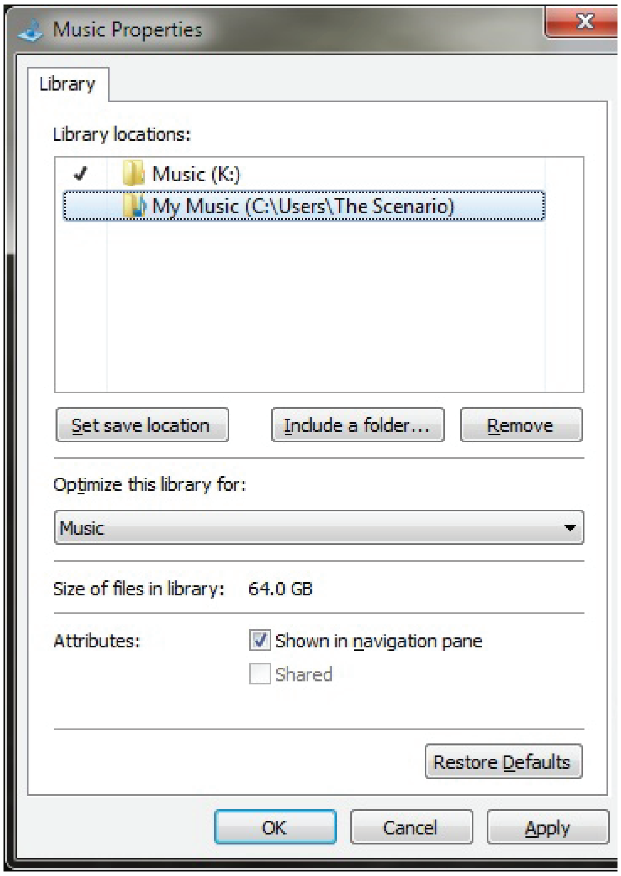
4 **4K ALIGNMENT** When moving an image from a hard drive to an SSD, you need to make sure both are "4K aligned" or performance can suffer. If you do a fresh install of the OS you never have to worry about this, but it can be a problem when transferring an install to a disk with partitions. You can check your drive's alignment by opening a command prompt and typing **wmic partition get Name, StartingOffset**. Take the number it gives you and divide by 4,096; if that results in an even number, you are aligned. If you're not, most SSD manufacturers provide software alignment tools that can help.



```
icrosoft Windows [Version 6.2.9200]
c) 2012 Microsoft Corporation. All rights reserve

:\Users\jnorem>wmic partition get name, startingo
ame                       StartingOffset
isk #0, Partition #0  1048576
isk #0, Partition #1  368050176
isk #1, Partition #0  16384


:\Users\jnorem>
```

LIVING WITH YOUR NEW SSD

TIPS ON GETTING YOUR NEW DRIVE TO WORK WITH YOUR OLD DRIVE



Library locations:
✓ Music (K:)
My Music (C:\Users\The Scenario)

Optimize this library for: Music

Size of files in library: 64.0 GB

Attributes: ☑ Shown in navigation pane
☐ Shared

We recommend keeping your user data on the large hard drive, and just linking to it from your new OS installation.

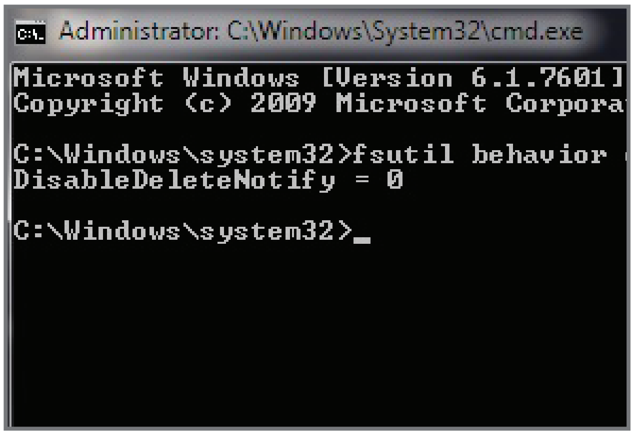
All installations of Windows have a Users folder that stores all your music, movies, documents, and pictures. As you can imagine, this folder can get quite large over time, so it's best to keep it off the SSD, as your SSD might not be large enough to hold all that data. Plus, in this scenario, all of this data already exists on your older hard drive, so we're going to keep it where it resides (on the hard drive) and just change the links to it within the OS. We'll show you how for one folder, then let you repeat it for the rest of the folders. On Windows 7, you can start by clicking the Start button, hovering over any of the user data links (music, movies, documents, or pictures), right-click, and select Properties. Next, click the button labeled "Include a folder..." and navigate to the folder on your old hard drive, which will typically be D:\Users\username\music, etc. Select that older folder, then highlight it in the window and click "Set save location." You can then select the Music folder on the C drive and click "remove." Click OK to save and you're done. Repeat these steps for the other links. Now when you click any of the links within the OS to user data, it'll open the folders on the hard drive.

MANAGING YOUR STEAM FOLDER

If you're like us, your Steam folder is Xbox huge, so we want to keep it on the old hard drive so that it doesn't saturate our shiny new SSD. This is rather simple actually, as you can just install Steam and when it prompts you for the installation location you can point to the hard drive and it should be able to "discover" the files that are already there and transition to that drive. If you already have Steam installed on your C drive and want to move it to the D drive, just do the following. Exit Steam, then open your Steam folder (C:\program files\Steam) and delete everything in the folder except the \steamapps folder, which is where all your games are stored. Copy and paste the folder into the new location (D:\games\Steam, for example), and rename the old folder but don't delete it, just in case. When you launch Steam it should find the new location, update itself, and all new games will be installed to this location going forward.

ENSURE TRIM IS WORKING

Once you are up and running you're going to want to check to make sure the Trim command is working. We can't say definitely that things would be bad if it wasn't, as the drive's built-in garbage collection routine should be able to accomplish the same goal, but it's good housekeeping to have it enabled. To do that, type **cmd** in the Start box in Windows, then right-click and select "Run as administrator." Next, type **fsutil behavior query DisableDeleteNotify** and see what value is returned. A "0" means it's working, a "1" means it's not. If the value is 1, type **fsutil behavior set DisableDeleteNotify 0** to turn it on, then run the original query again to make sure it's enabled. Now you're Trimming!



```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corpora

C:\Windows\system32>fsutil behavior
DisableDeleteNotify = 0

C:\Windows\system32>_
```

Checking to see if Trim is enabled requires a simple DOS query (hell yeah, old school).

THE SSD LEADER-BOARD

ALL THE TOP SSDs BENCHMARKED AND COMPARED

If you have the patience to comb through the chart below, you'll notice a few patterns. First, all the drives with five-year warranties are the top performers in every benchmark, and there's a reason for that. A five-year warranty is pretty much the calling card of the premium drives, so those drives are the best of the best. In addition to a super-long warranty, these drives also offer highly tuned controllers and high-quality NAND flash, hence the premium performance across the board. Our Best of the Best drive in the top tier is the Samsung 840 Pro, as it has class-leading performance, is priced competitively, and features a software package that's head-and-shoulders above anything the competition offers. Also, we have to add a note here about OCZ drives, because as we went to press the company was in the process of being sold to Toshiba. It obviously doesn't affect the Vector's smokin' performance, but warranty support is somewhat of a question mark, so we'd steer clear of that drive until the matter is settled.

Moving down one tier to the drives with a three-year warranty, it's very close between the Crucial M500, Samsung 840 Evo, Seagate 600, and Intel 335—all show reduced performance compared to the big-boy SSDs, natch, but for day-to-day tasks they are more than adequate. The Samsung 840 Evo is the outlier in this group, as it has the ability to outpace many of the five-year-warranty drives, thanks to its so-called Rapid Mode, which can cache files via DRAM. Because of this performance advantage, the software mentioned above, and Samsung's excellent reputation, we recommend the Samsung 840 Evo at this tier since it offers an unbeatable combination of performance at a midrange price.

At the end of the day, the truth is that any modern SSD will feel extremely fast, especially if you've never used one before. You honestly won't be able to feel the difference between 500MB/s and 429MB/s on a day-to-day basis, so choose a drive you can afford that you think will be reliable, and as always, back up any data you have that is crucial, because any drive can fail at any time. The fact is, SSDs are just as prone to failure as spinning drives. In our experience, they have become more reliable as their technology matures, but as always, do your research before you buy.

BENCHMARKS

	Samsung 840 Pro	Corsair Neutron GTX	SanDisk Extreme II	Plextor M5 Pro	OCZ Vector	Samsung 840 Evo (Rapid Mode)	Samsung 840 Evo (Normal Mode)	Crucial M500	Seagate 600	Intel 335
Controller	MDX	LAMD	Marvell 88SS9187	Marvell 88SS9187	Barefoot 3	MEX	MEX	Marvell 88SS9187	LAMD	SF-2281
Capacity	512GB	480GB	480GB	256GB	512GB	1TB	1TB	480GB	240GB	240GB
Warranty	5 years	5 years	5 years	5 years	5 years	3 years	3 years	3 years	3 years*	3 years
CrystalDiskMark										
Avg. Sustained Read (MB/s)	534	441	521	534	502	**594**	519	480	515	470
Avg. Sustained Write (MB/s)	514	478	484	451	499	**591**	500	422	462	240
AS SSD - Compressed Data										
Avg. Sustained Read (MB/s)	513	507	511	510	507	**855**	506	493	510	492
Avg. Sustained Write (MB/s)	495	475	425	443	494	**1,002**	496	408	435	214
ATTO										
64KB File Read (MB/s)	524	345	525	479	511	519	494	502	**526**	430
64KB File Write (MB/s, 4QD)	497	485	493	371	480	**659**	510	422	465	502
Iometer										
4KB Random Write 32QD (IOPS)	82,927	85,375	42,699	84,870	83,531	88,859	**89,423**	83,354	84,390	42,289
PCMark Vantage x64	75,205	67,426	38,093	78,218	75,863	**100,797**	57,306	71,619	58,145	47,571
Sony Vegas Pro 9 Write (sec)	294	286	275	340	314	**272**	277	485	322	634

Best scores are bolded. All tests conducted on our hard drive test bench, which consists of a Gigabyte Z77X-UP4 motherboard, Intel Core i5-3470 3.2GHz CPU, 8GB of RAM, Intel 520 Series SSD, and a Cooler Master 450W power supply.
*Seagate covers the drive for 73TB of writes or 3 years, whichever comes first.

Wireless

Seven AC Routers Compared

TRENDnet
NETGEAR
LINKSYS
LINKSYS
RT-AC66U Dual Band 3x3
802.11AC Gigabit Router
ASUS

Gone Wild

EVERYTHING YOU NEED TO KNOW ABOUT THE 802.11AC STANDARD

BY PAUL LILLY

Even though you might just now be getting around to upgrading your home network to take advantage of the 802.11n spec, there's a new standard on the horizon that promises even faster speeds. How fast? Well, if 802.11n is a pitcher's fastball, the draft 802.11ac spec is a bullet fired from a gun, at least in theoretical terms.

Unless you live in an underground bunker completely isolated from interfering signals and find yourself favored by the gods of Wi-Fi, you'll never come close to 802.11ac's theoretical maximum of 1.3 gigabits per second (assuming a three-antenna design). Overhead, interference, and a number of other factors poop on the Wi-Fi party, but the same is true of earlier standards, so you'll still see a net gain in performance. How much depends on your setup, but in general, real-world 802.11ac performance ends up being around twice as fast as 802.11n, which bodes well for streaming HD videos, gaming, and file transfers.

One of the reasons why 802.11ac is so much faster is because it taps into wider channels. As part of the spec, 802.11ac must support 80MHz channel bonding (160MHz is optional), up from the maximum of 40MHz in 802.11n. It also boasts twice as many multiple input, multiple output (MIMO) streams at eight.

Before you rip out your router and replace it with an AC model, there are some things you should know. We'll tell you what they are, and then dive into a roundup of seven 802.11ac routers available now.

LINKSYS
LINKSYS
EA6900

AC BUYER'S GUIDE

What to look for when upgrading your home network

DON'T FORGET THE ADAPTER

The 802.11ac spec should be finalized in early 2014, perhaps even by the time you're reading this. Until then, don't expect to see a lot of systems natively support the new standard. So, you'll need an 802.11ac adapter, of which there are a growing number to choose from.

BUILT-IN USB PORTS

A router with at least one USB port should allow you to plug in an external storage device and share files across your network. For this, a USB 3.0 port works best. You can also share a printer over your network through your router's USB port, though only if the router supports this feature. Not all do, so you'll want to verify that the model you're considering does if this is a must-have feature.

DECODING AC1300, AC1750, AND AC1900

Router makers use clever marketing tactics to help their products stand out from the crowd. One of the most common tricks is to add the 2.4GHz (up to 450Mb/s) and 5GHz (up to 1,300Mb/s) channels together to arrive at a higher, more attractive number. AC1750 looks and sounds faster than AC1300, so why not use the bigger number? It's a bit deceptive because you can't actually combine the two channels for a faster connection. Some, like Linksys and Netgear, advertise AC1900 for their highest-end routers, and that's because the 2.4GHz channel supports a 600Mb/s data rate due to the use of 256-QAM (quadrature amplitude modulation) instead of the more common 64-QAM. This provides a real-world benefit, but only if your Wi-Fi adapter also supports 256-QAM.

BEAMFORMING

Instead of sending a signal out in all directions, routers that support beamforming are able to focus the signal toward a client for better performance, reliability, and range. A good analogy is to think of a how a light bulb (traditional router) casts its light in every direction, whereas a flashlight (router with beamforming) focuses its energy on a specific target. Even better, beamforming can focus on multiple targets, not just one.

HOW WE TEST

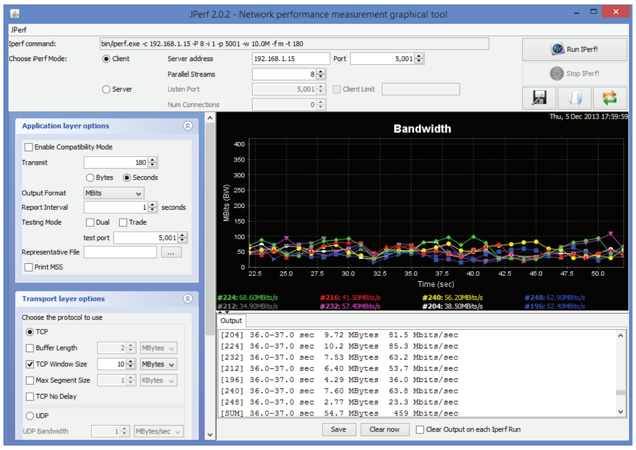
Maximum PC Lab Midwest

For the past several years, we've been testing routers at Maximum PC Lab North, a 2,800-square-foot home located on 10 acres of what was once a dairy farm. The new location is Maximum PC Lab Midwest, a 1,400-square-foot home flanked by houses on either side, a yard extending into a wooded area out back, and a semi-busy road in front. The new location offers a harsher, more real-world testing environment.

We measure the performance of each router in five separate locations starting with the Bedroom in a spot 10 feet away from the router with no obstructions. The next test takes place in the Dining Room 15 feet from the router and separated by two walls, followed by the Entryway with 20 feet and three walls of separation. The final two tests take place outside in the Driveway (35 feet) and Backyard (90 feet) toward the edge of a wooded area.

When possible, each dual-band router is configured to run in 802.11n-only mode on the 2.4GHz channel and 802.11ac-only mode on the 5GHz channel, both with WPA2 encryption and channel bonding. We use the open-source Jperf utility, a GUI front end for Iperf, to measure throughput in each of the five locations. Our Jperf server is an HP Envy Ultrabook with a Core i5 processor wired directly to the router being tested, and the client PC is a Dell Inspiron laptop with a Core i3 processor. Since the client PC doesn't support 802.11ac natively, we run the tests with a Linksys USB6300 dual-band USB adapter. We compare the 802.11n scores to our zero-point router, an Asus RT-N66U.

Finally, we also test each router's attached storage performance by plugging in a 32GB Lexar JumpDrive P10 USB 3.0 flash drive. We chose this drive because it's one of the fastest on the market with up to 265MB/s read and 245MB/s write performance. Once configured, we use a stopwatch to time how long it takes to write a single 3GB file to the flash drive and then again with a 1GB folder containing several smaller files. We repeat both tests to read the large and small files to the hardwired server PC. All the benchmark results can be seen on page 43.



Iperf command: bin/iperf.exe -c 192.168.1.15 -P 8 -i 1 -p 5001 -w 10.0M -f m -t 180
Choose iPerf Mode: ● Client ○ Server
Server address 192.168.1.15 Port 5,001
Parallel Streams 8
Listen Port 5,001 ☐ Client Limit
Num Connections 0

☐ Enable Compatibility Mode
Transmit 180 ○ Bytes ● Seconds
Output Format MBits
Report Interval 1 seconds
Testing Mode ☐ Dual ☐ Trade
test port 5,001
Representative File
☐ Print MSS

Choose the protocol to use
● TCP
☐ Buffer Length 2 MBytes
☑ TCP Window Size 10 MBytes
☐ Max Segment Size 1 KBytes
☐ TCP No Delay
○ UDP
UDP Bandwidth 1 MBytes/sec

#224: 68.60MBits/s #216: 41.50MBits/s #240: 56.20MBits/s #248: 62.90MBits/s
#212: 34.90MBits/s #232: 57.40MBits/s #204: 38.50MBits/s #196: 52.40MBits/s

```
[204] 36.0-37.0 sec  9.72 MBytes  81.5 Mbits/sec
[224] 36.0-37.0 sec  10.2 MBytes  85.3 Mbits/sec
[232] 36.0-37.0 sec  7.53 MBytes  63.2 Mbits/sec
[212] 36.0-37.0 sec  6.40 MBytes  53.7 Mbits/sec
[196] 36.0-37.0 sec  4.29 MBytes  36.0 Mbits/sec
[240] 36.0-37.0 sec  7.60 MBytes  63.8 Mbits/sec
[248] 36.0-37.0 sec  2.77 MBytes  23.3 Mbits/sec
[SUM] 36.0-37.0 sec  54.7 MBytes   459 Mbits/sec
```

☐ Clear Output on each Iperf Run

Jperf's wealth of settings aren't just good for benchmarking; you can use the open-source app to troubleshoot your network, too.

D-LINK DIR-868

Simple design with a confusing interface

ROUTERS COME in all shapes and sizes, and after spending time with an assortment of boxy models with antennas extending every which way, D-Link's cylindrical DIR-868 is a welcome change. It's not overly big and looks rather neatly groomed compared to the other routers in this roundup, but looks will only get you so far.

With regard to brawn, the DIR-868 offers exceptional range on the 5GHz channel in 802.11ac mode, delivering 15.1Mb/s in the Backyard test at a distance of 90 feet. Technically, that makes the DIR-868 the second-fastest at that range, though it virtually tied Netgear's model at 15.3Mb/s for pole position. Since this test is outside, a fly belch could explain the tiny difference.

The DIR-868 didn't fare as well on the 2.4GHz channel in 802.11n mode. Its performance wasn't bad, just merely average, and it certainly never threatened our zero-point router. However, its file-transfer performance using the built-in USB 3.0 port was among the fastest.

Initial setup of the DIR-868 was pretty painless, though the fugly web-based interface could use a major overhaul. It's way too wordy and not very intuitive to navigate, especially for less savvy users and/or anyone who's unfamiliar with networking nomenclature.

Nestled inside the cylindrical DIR-868L are half a dozen antennas with beamforming support.

VERDICT 7

D-Link DIR-868

$155 (street), www.dlink.com

TRENDNET TEW-812DRU

Plain looks meet plain performance

DESPITE THIS router's high MSRP, we've seen this model retail for a Benjamin online, giving users a comparatively inexpensive upgrade path to 802.11ac territory. The old adage "You get what you pay for" applies here because even though the TEW-812DRU supports the AC spec, its performance on the 5GHz channel in 802.11ac mode consistently trailed the competition. In our two outside tests—Driveway and Backyard—the performance gap was especially noticeable. Throughput on the 2.4GHz in 802.11n mode fared better at close distances, but again became strained as we moved farther away from the router.

Trendnet deserves major props for a well-designed web interface that's straightforward and easy to navigate. The main screen provides you with an uncluttered glimpse of your network situation, and Trendnet even figured out a way to include a bit of fine-grain control in the Basic view. Naturally, there are a lot more levers to pull in the Advanced tab, but you'll still never feel lost or overwhelmed.

You can share files by connecting a drive to the router's single USB 2.0 port, though transfer speeds are hindered by Trendnet's decision to forego USB 3.0. And while it offers FTP and Samba support, no DLNA is a buzzkill.

5G
2.4G
4
3
2
1
TRENDnet

Low street pricing is this router's saving grace.

VERDICT 6

Trendnet TEW-812DRU

$140 (street), www.trendnet.com

LINKSYS EA6900

Belkin's first product under the Linksys name

THE LINKSYS brand has managed to survive two acquisitions in the past 10 years, first by Cisco in 2003, and more recently by Belkin in 2013. Apparently, the Linksys name isn't enough because Belkin also calls the EA6900 the Linksys Smart Wi-Fi AC1900. The "Smart" portion of that title denotes the availability of Smart apps you can install on the router, and the AC1900 is a sum of the 2.4GHz (up to 600Mb/s) and 5GHz (up to 1,300Mb/s) bands added together. Give the marketing team a cookie.

Beyond the talk, the EA6900 walks the walk with acceptable 802.11ac performance on the 5GHz band and blazing-fast 802.11n throughput on the 2.4GHz band. It obliterated the zero-point router in the three indoor tests, and split the two outdoor tests, losing by less than 3Mb/s in the Backyard—impressive.

There are two USB ports on the back, one Hi-Speed (2.0) and one SuperSpeed (3.0), though the latter acted like the former by registering a pokey 6:09 (min:sec) to write a 3GB file to the attached storage device. However, both ports support DLNA and allow you to share a printer across your network.

Overall, a solid first effort by Belkin.

Belkin proves with the EA6900 that Linksys is in good hands going forward.

LINKSYS
EA6900

VERDICT 8

Linksys EA6900

$195 (street), www.linksys.com

NETGEAR R7000

So fast it should be illegal

IF YOU HAVE the space to park Netgear's mammoth R7000, otherwise known as the Nighthawk, the router will pay its rent by serving up blistering-fast throughput on both the 2.4GHz and 5GHz bands in 802.11n and 802.11ac modes, respectively. It posted the fastest AC performance by far in the Entryway (336Mb/s), which is 20 feet away from the router and separated by three walls, and had the best range of the bunch. Overall, it was one of the more consistent-performing routers, and also demonstrated an intelligent ability to pick out less-crowded channels on its own—that's a great commodity for novice users.

Netgear has put in a lot of work over the past few years making its web interface more user friendly, but that hasn't come at the expense of advanced knobs and dials. If you like to tinker with your network settings, you'll find a host of options to play with, including robust QoS controls, which look at both upstream and downstream traffic.

There are two USB ports on the Nighthawk, including a USB 3.0 port conveniently located on the front. In our file-transfer tests, the Nighthawk ran the table, leaving the other routers in the dust.

The aggressive design and "Nighthawk" name are both inspired by the Lockheed F-117 Nighthawk stealth attack aircraft.

VERDICT 9

KICK ASS!

Netgear R7000

$200 (street), www.netgear.com

ASUS RT-AC66U

This router rises about its predecessor, the Dark Knight (RT-N66U)

ASUS NICKNAMED its last-generation router—and our zero-point in this roundup—Dark Knight, and if it's looking for another DC Comics hero to represent the RT-AC66U, we recommend going with The Flash. Point blank, this is the all-around fastest router we've ever tested. It came out on top in five of our 10 throughput tests and nipped at the heels of the leader in three others.

A pair of slower USB 2.0 (compared to USB 3.0) ports on the back temper our enthusiasm over performance, though at least Asus offers a host of ways to share and stream files—DLNA, iTunes, FTP, and Samba server support all showed up to the party. You can also use Asus's AiCloud app available on Android and iOS to tap into your files from a mobile device.

The user interface is brilliantly mapped out and chock-full of settings. All the main functions are categorized on the left-hand side, while tabs on the main window allow you to dig several layers deep. Power users and novices alike will feel right at home jumping around the menu. It's also nice that Asus gives you the ability to tweak the signal strength and external antennas.

RT-AC66U Dual Band 3x3
802.11AC Gigabit Router
ASUS

If speed kills, this router would be a serial killer.

VERDICT 9 KICK ASS!

Asus RT-AC66U

$180 (street), www.asus.com

AMPED WIRELESS RTA15

High maintenance, low reward

WE'RE NOT SURE if the RTA15 is so potentially fast that it keeps tripping over its own two feet, or if this is a case of being seduced by promises of a wild ride by a hot number that has no intentions of following through. Either way, we were left frustrated and unsatisfied.

Amped Wireless advertises the RTA15 as a "High Power 700mW" router, yielding expectations of both speed and distance. During our tests, we saw glimpses of the former—the RTA15 would spike on the 5GHz band before taking a dip in performance. Averaged out over time, the best we could muster was just shy of 300Mb/s, and even that took a lot of tinkering. We spent way more time experimenting with settings on the RTA15 than any other router. One thing we discovered is that dialing back the signal strength helps in close quarters, but we never did uncover the magic formula that would make this router scream.

File transfer speeds over the single USB 2.0 port failed to impress, as well. It was among the slowest of the bunch, taking a minute and a half longer than any other router to write a single 3GB file.

amped|wireless

Move along. This is not the AC router you're looking for.

VERDICT 5

Amped Wireless RTA15

$185 (street), www.ampedwireless.com

BUFFALO WZR-1750DHP

Don't judge a router by its cover

WHEREAS HIGH-PERFORMANCE routers are adopting sleek designs with aggressive angles and external antennas, Buffalo's WZR-1750DHP stands up like a hardcover book with subdued LEDs and a rubberized coating. This isn't a fashion contest, however, and Buffalo's model quickly demonstrated why looks mean nothing. Throughput on the 5GHz band in 802.11ac mode consistently bumped elbows with Asus and Netgear, with Buffalo edging out both in the Entryway. 802.11n and file-transfer performance via USB 3.0 were both solid, too.

A wealth of advanced features can be found in the back end, including some not-so-common tweaks like an eco mode and an optional time limit for guest access. Buffalo earns bonus points for a persistent Help button in the upper-right corner. Clicking it brings up an explanation of whichever settings are on the page—we wish more router makers would follow in Buffalo's footsteps here.

Zooming through the menu system is a little quirky. The main menu is the most touch-friendly of the bunch with four large, tiled menus, but the deeper you go, the more traditional (and a little confusing) the menus get. Given the focus on touch computing lately, we hope Buffalo eventually extends the main menu look throughout the UI.

AOSS
AirStation
BUFFALO

Exceptional speed and features belie this router's unassuming looks.

VERDICT
9

Buffalo WZR-1750DHP

$140 (street), www.buffalotech.com

AC ROUTERS COMPARED

5GHZ 802.11AC

	D-Link	Trendnet	Linksys	Netgear	Asus	Amped	Buffalo	Asus Zero-Point
Bedroom – 10ft (Mb/s)	416	324	361	400	**419**	298	398	N/A
Dining Room – 15ft, 2 walls (Mb/s)	243	221	239	291	**335**	138	309	N/A
Entryway – 20ft, 3 walls (Mb/s)	257	178	241	**336**	284	112	268	N/A
Driveway – 35ft (Mb/s)	67.8	20.2	63.7	136	132	42.4	**138**	N/A
Backyard – 90ft (Mb/s)	15.1	2.76	11.1	**15.3**	9.54	2.81	14.3	N/A

Best scores are bolded.

2.4GHZ 802.11N

	D-Link	Trendnet	Linksys	Netgear	Asus	Amped	Buffalo	Asus Zero-Point
Bedroom – 10ft (Mb/s)	79.5	97.1	170	96.4	**180**	159	**180**	111
Dining Room – 15ft, 2 walls (Mb/s)	65.6	95.2	140	93.4	**163**	66	141	99.3
Entryway – 20ft, 3 walls (Mb/s)	62.3	42.2	**149**	88.3	145	50.4	91.7	122
Driveway – 35ft (Mb/s)	42.8	31.4	80	78.7	**95.5**	4.13	64.4	73.4
Backyard – 90ft (Mb/s)	4.31	23.8	56.4	54.4	58.4	2.35	51.4	**59.1**

Best scores are bolded.

FILE TRANSFERS

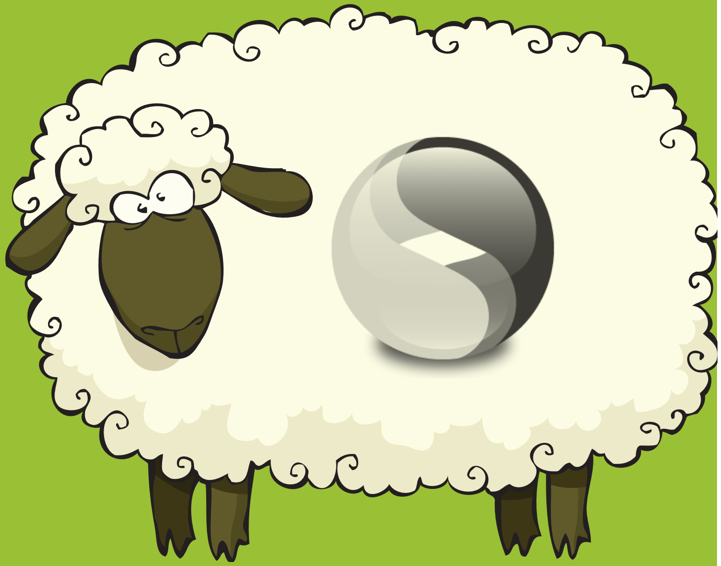
	D-Link	Trendnet	Linksys	Netgear	Asus	Amped	Buffalo	Asus Zero-Point
3GB Router to PC (min:sec)	1:38	2:16	1:41	**0:50**	4:29	6:20	1:12	4:28
1GB Router to PC (min:sec)	0:39	2:16	0:40	**0:22**	1:35	2:14	0:29	1:52
3GB PC to Router (min:sec)	2:51	4:33	6:09	**1:31**	6:00	7:45	2:15	6:15
1GB PC to Router (min:sec)	1:10	2:58	2:26	**0:40**	2:25	2:35	0:59	2:34

Best scores are bolded.

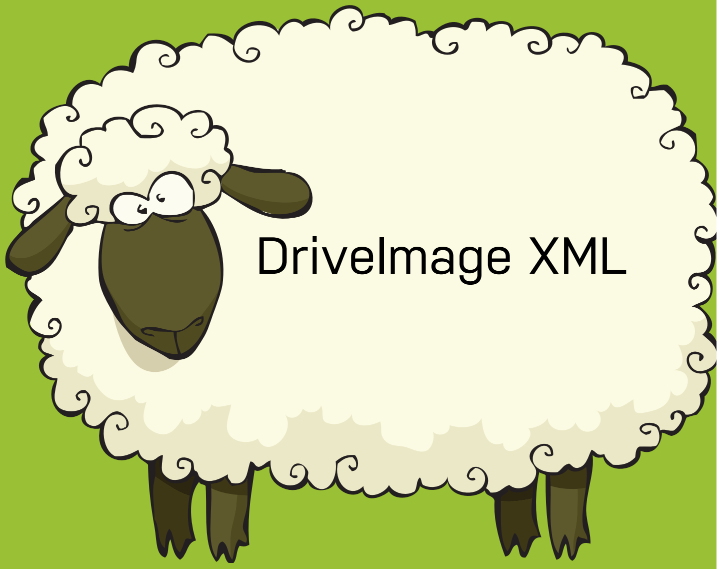
STORAGECRAFT.
SHADOWPROTECT 5
DESKTOP

Acronis

Powered by
Clonezilla



Macrium
Reflect


DriveImage XML

SEND IN THE CLONES

WE PUT SIX DISK-CLONING AND BACKUP UTILITIES UNDER THE MICROSCOPE

BY MARCO CHIAPPETTA

Cloning and disk-imaging software is infinitely useful for end users and IT managers alike. Whether you're just making backups of a single partition, blasting full images to dozens of systems across a network, or creating virtual machines for a testing environment, cloning software has got you covered. Not all cloning applications and utilities are created equal, though. There are numerous options available, at various price points—including free—with a diverse range of integrated features.

In some ways, all cloning and imaging utilities are similar. Assuming they work properly, at their most basic level, cloning utilities make bit-by-bit, accurate clones—or images—of a drive or partition. And those images can be quickly and easily restored or moved to a new drive (or VM) in the event of a problem. There are plenty of cloning utilities to choose from, and Windows itself even has the ability to create disk images built right in. But if you start to dig in and compare the options and capabilities of the multitude of utilities out there, you'll quickly find that their lists of features are as varied as their price points.

Fret not. We have rounded up a half-dozen cloning and disk-imaging utilities and will attempt to demystify the selection process for you here. If you're looking for a basic, free solution that does little else but clone disks or create images, or a more comprehensive product that also offers some cloud storage for backups, we've got something on tap that fits the bill.

ACRONIS TRUE IMAGE 2014

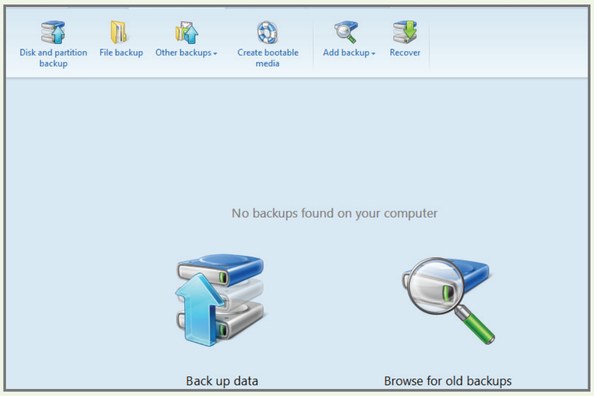
Loaded with features and relatively affordable

THE MOMENT you launch True Image 2014, it is immediately clear that the folks at Acronis get it. Although Acronis True Image offers arguably the most comprehensive set of features in the group, it also sports the most well-organized, easiest-to-navigate menu system of the bunch.

At first, users are given the choice to take a virtual tour of the various parts of the program, which explains how to back up data, when to recover data, and how to leverage Acronis's cloud storage capabilities (5GB, free). Novices should definitely take advantage of Acronis's help system, as it lays a solid foundation and does a good job explaining many of the program's features.

As users tunnel deeper into Acronis True Image 2014's menus, they'll find a wealth of options for cloning disks, creating images, performing incremental backups, synchronizing folders, creating recovery media, and much more.

Not only is Acronis True Image 2014 relatively easy to use and loaded with a wealth of features, it's also the most affordable of the paid options featured here. At $50 for the standard desktop edition, Acronis True Image 2014 isn't exactly a steal, especially when there are competent, free alternatives available, but it's certainly an application we'd buy if we were in need of a comprehensive all-in-one disk-cloning and backup solution.



No backups found on your computer

Despite a plethora of options, True Image 2014 is surprisingly easy to navigate.

VERDICT
9
KICK ASS!

Acronis True Image 2014

$50, www.acronis.com

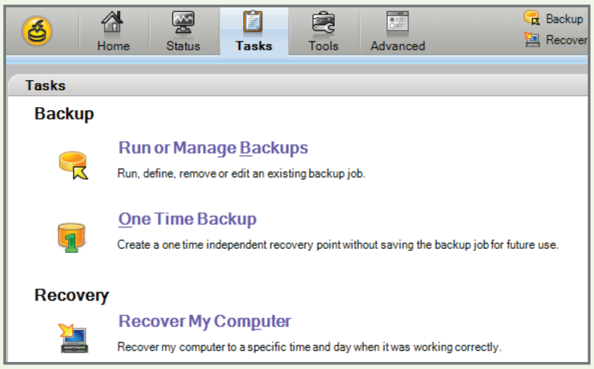
SYMANTEC SYSTEM RECOVERY 2013 DESKTOP EDITION

Norton Ghost reincarnated, with new name and additional features

FOR YEARS, WHEN you discussed cloning or imaging a system, Norton Ghost came to mind. The utility was so popular, in fact, that somewhat like Google, the brand became a verb: "Ghosting" a system was synonymous with cloning a drive or taking a system image. Earlier this year, though, Symantec discontinued development of Norton Ghost and moved on to a new, all-encompassing cloning and backup solution dubbed Symantec System Recovery.

Symantec System Recovery is offered in a few versions, which target home, corporate, or enterprise users. It is the $85 Symantec System Recovery 2013 Desktop Edition of the software that will be of most interest to you, our good readers. Like Acronis True Image, Symantec System Recovery 2013 can do everything from incremental backups to full drive clones, and the utility supports virtually any type of storage media, from USB flash drives to network volumes. Symantec System Recovery 2013 can even send backup images and data to an offsite FTP.

Although Symantec System Recovery 2013 Desktop Edition is feature-rich and should be easy enough to navigate for knowledgeable PC users, its interface and UI aren't quite as refined as Acronis True Image 2014, in our opinion. It is also the more expensive option of the two. Ultimately, though, Symantec System Recovery 2013 Desktop Edition is a quality product, worthy of consideration, especially if you're already intimately familiar with Ghost.



Run, define, remove or edit an existing backup job.

Create a one time independent recovery point without saving the backup job for future use.

Recover my computer to a specific time and day when it was working correctly.

Symantec System Recovery 2013 Desktop Edition has got it all, and then some.

VERDICT
8

Symantec System Recovery 2013 Desktop Edition

$85, www.symantec.com

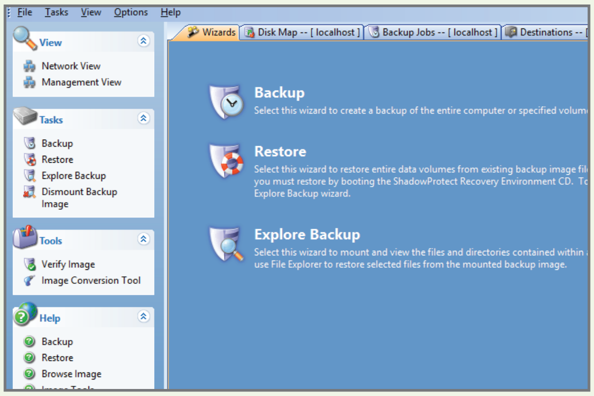
SHADOWPROTECT DESKTOP 5

Powerful, easy to use, and has enterprise-class DNA

STORAGECRAFT, A RESPECTED provider of enterprise-class backup solutions, scaled down some of its wares to produce ShadowProtect Desktop 5. One of the advantages to having enterprise-class roots is that ShadowProtect Desktop 5 is about as reliable as they come, but the app also looks somewhat dated in comparison to competing products from Acronis and Symantec. It also seems like the developers of ShadowProtect Desktop assume their users have a certain level of expertise with image-based backup solutions, because the program's help system isn't terribly detailed.

With that said, experienced PC users will probably dig a number of ShadowProtect Desktop 5's features. The utility can take images of disks or partitions and save them virtually anywhere. After an initial image is created, the program can then take incremental backups at whatever schedule the user desires. ShadowProtect Desktop 5 will also let users open images to restore individual files or folders, and images created with the program can be launched as a VM inside VirtualBox, should users want to experiment on an image without necessarily restoring files.

It's not the prettiest of the apps featured here, and ShadowProtect Desktop 5 is the most expensive by a few bucks, but it's a powerful solution that will serve savvy users well.



Backup

Select this wizard to create a backup of the entire computer or specified volum

Restore

Select this wizard to restore entire data volumes from existing backup image fil
you must restore by booting the ShadowProtect Recovery Environment CD.
Explore Backup wizard.

Explore Backup

Select this wizard to mount and view the files and directories contained within
use File Explorer to restore selected files from the mounted backup image.

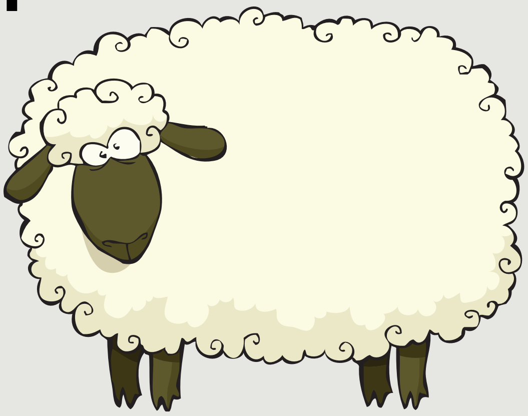
It may not be as well known as its rivals, but ShadowProtect Desktop 5 is an excellent image-based backup suite.

VERDICT
9

ShadowProtect Desktop 5

$90, www.storagecraft.com

MAKING THE MOST OF CLONING SOFTWARE



The most obvious reason to use cloning software is to back up your personal data and maintain a cloned image of your system in case of a catastrophic problem, but cloning software can be used for much more than that.

When setting up a system for the first time, we like to take multiple images throughout the setup process, in the event we want to experiment with different drivers or software on the system or just want to restore it to a given point. For example, we'll take an image right after installing the OS, another after installing drivers and running updates, and another when all of our applications are installed and configured. Over time, we'll also capture new images as we add more applications or tweak settings to our liking. Ultimately, you'll end up with a collection of images that allow for quick recovery without ever having to go through the hassle of reinstalling an OS and apps from scratch. If you get the itch to start with a fresh OS install, you can simply restore the clean image and be off and running in minutes.

Cloned disk images can also be used to create Virtual Machines that mimic your main rig, should you want to experiment with software or other settings in a sandboxed environment. Instead of restoring an image to a physical drive, simply configure your virtual machine and restore your cloned image to the virtual drive using its standard recovery tools. It's not quite like having separate machines, but using a VM for trial-ware or other software is a great way to keep your rig free from junk and other unwanted stuff that tends to creep in over time, like toolbars and other widgets.

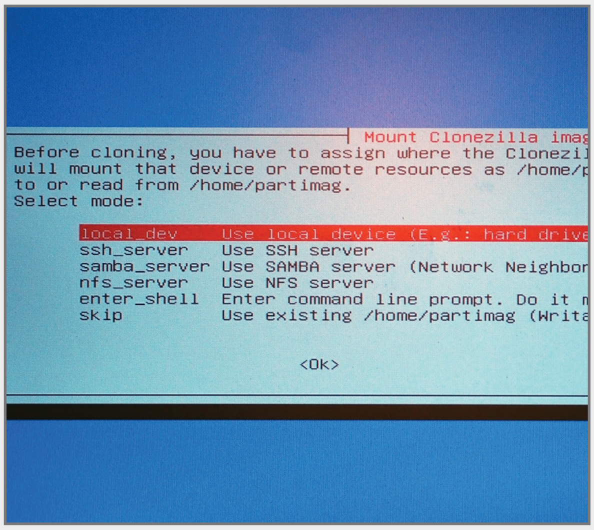
CLONEZILLA LIVE

It ain't pretty, but it gets the job done

IF ACRONIS TRUE Image 2014 and Symantec System Recovery 2013 Desktop Edition are akin to expensive, luxury sedans packed with every amenity known to man, CloneZilla Live is a stripped-down, lightweight drag-racer that doesn't even have gauges, let alone seat belts or headlights.

CloneZilla is offered in two versions, CloneZilla SE (Server Edition), which can be used to clone many machines from across a network, or CloneZilla Live, which is designed for end users looking for a no-nonsense partition- and disk-cloning solution. CloneZilla Live is built around a Debian Live Linux distro and is offered as a free download, licensed under the GNU General Public License (GPL) Version 2. It can be run from a bootable disc or USB thumb drive and does nothing but clone disks or partitions. There are no hooks for cloud storage and there's no fancy user interface.

Less savvy users, with little or no experience outside of Windows' GUI, may be taken aback when CloneZilla first launches. The UI can be somewhat daunting, especially for users not comfortable with the syntax used. That said, CloneZilla is as reliable as they come and you can't knock free.



```
                                         Mount Clonezilla imag
Before cloning, you have to assign where the Clonezil
will mount that device or remote resources as /home/p
to or read from /home/partimag.
Select mode:

         local_dev      Use local device (E.g.: hard drive
         ssh_server     Use SSH server
         samba_server   Use SAMBA server (Network Neighbor
         nfs_server     Use NFS server
         enter_shell    Enter command line prompt. Do it m
         skip           Use existing /home/partimag (Writa

                               <Ok>
```

CloneZilla's UI and seemingly complex syntax may scare off less savvy users.

VERDICT
6

CloneZilla Live

Free, clonezilla.org

MACRIUM REFLECT FREE EDITION

It's fine for the basics but not much else

MACRIUM REFLECT Free Edition is a cut-down version of Macrium Software's more complete paid editions, which are offered in Standard ($45), Professional ($59), and Enterprise ($200) versions, each with an increasingly robust feature set. The good news with this arrangement is that Macrium Reflect Free is a relatively refined, easy-to-use cloning and imaging solution. The bad news is that it's missing a handful of useful features, like incremental and file/folder backups, and it's also incompatible with dynamic disks.

If you plan to stick with basic disk imaging or cloning, however, Macrium Reflect Free is fairly nice. We found the program to be fast and reliable and it also offers the ability to access images created with the program in Windows Explorer.

We suspect users that give Macrium Reflect Free a shot—and like it—will probably want to spring for the Standard edition, as it adds a number of features that would make the program feel much more complete.

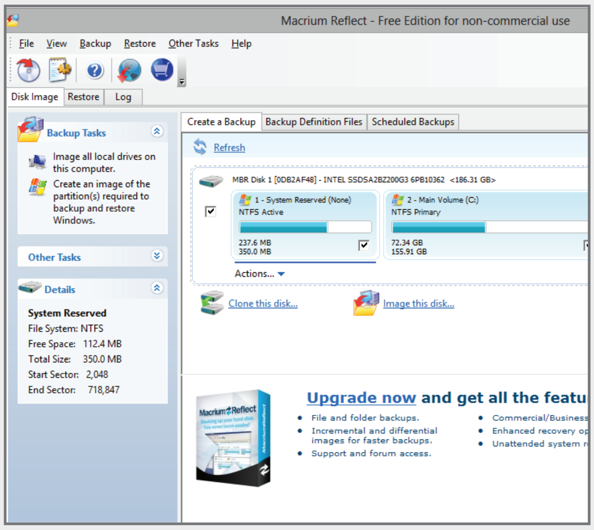


Image all local drives on this computer.

Create an image of the partition(s) required to backup and restore Windows.

System Reserved
File System: NTFS
Free Space: 112.4 MB
Total Size: 350.0 MB
Start Sector: 2,048
End Sector: 718,847

MBR Disk 1 [0DB2AF48] - INTEL SSDSA2BZ200G3 6PB10362 <186.31 GB>

☑ 1 - System Reserved (None)
NTFS Active
237.6 MB
350.0 MB ☑

2 - Main Volume (C:)
NTFS Primary
72.34 GB
155.91 GB

Upgrade now and get all the featu

- File and folder backups.
- Incremental and differential images for faster backups.
- Support and forum access.
- Commercial/Business
- Enhanced recovery op
- Unattended system r

It's fast and free, but lacks many features available in the paid editions.

VERDICT
6

Macrium Reflect Free Edition

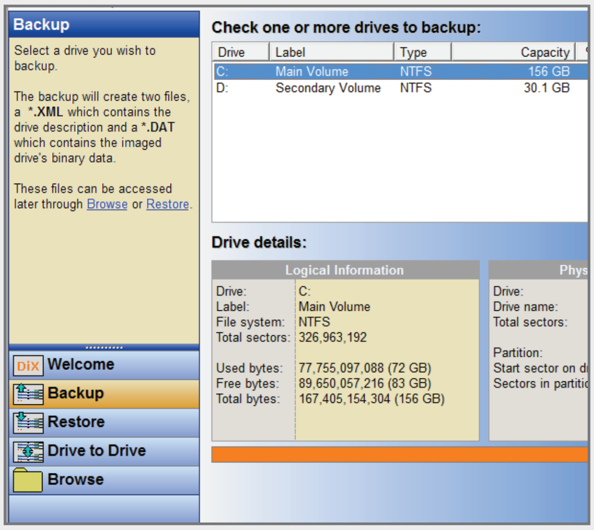
Free, www.macrium.com

DRIVEIMAGE XML

Too little, too late

WE'LL FREELY admit that there are some hardcore users out there who prefer streamlined, specialized applications that do only one thing, but do it well. DriveImage XML falls into that category. This tiny, less-than-1MB download is a straightforward disk-imaging solution that does little else. The program installs in seconds and functions exactly as you'd expect—select a source, select a destination, and the program will create a backup image. It does not, however, offer the ability to take incremental backups and it doesn't help create rescue media, either.

If you check out DriveImage XML and like it, great. More power to you. It's reliable and has been around for a number of years (which is made abundantly clear from its interface's '90s-era look), and makes for a decent no-nonsense free backup and imaging solution. Windows' own built-in solution does essentially the same thing though, and it's more user-friendly to boot. ⏻



Select a drive you wish to backup.

The backup will create two files, a *.XML which contains the drive description and a *.DAT which contains the imaged drive's binary data.

These files can be accessed later through Browse or Restore.

Check one or more drives to backup:

Drive	Label	Type	Capacity
C:	Main Volume	NTFS	156 GB
D:	Secondary Volume	NTFS	30.1 GB

Drive details:

Logical Information

Drive: C:
Label: Main Volume
File system: NTFS
Total sectors: 326,963,192

Used bytes: 77,755,097,088 (72 GB)
Free bytes: 89,650,057,216 (83 GB)
Total bytes: 167,405,154,304 (156 GB)

Phys

Drive:
Drive name:
Total sectors:

Partition:
Start sector on d
Sectors in partitio

DriveImage XML works as advertised, but not a whole lot else.

VERDICT 5

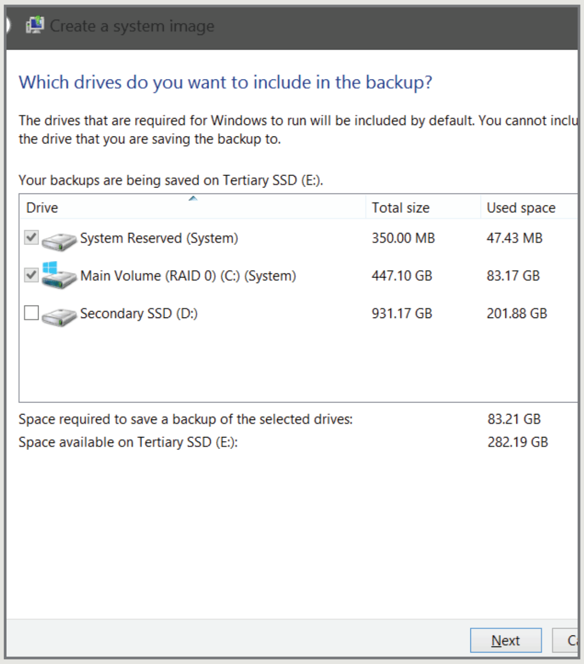
DriveImage XML

Free, www.runtime.org

WHY NOT JUST USE WINDOWS?

Microsoft introduced a relatively capable backup tool in Windows 7 that has since been carried over into Windows 8 and 8.1. The aptly named Windows 7 File Recovery tool (it retains the same name in Windows 8/8.1, oddly enough) gives users the ability to back up personal files from their libraries or to create full system images and rescue discs. If you're looking for a simple, basic backup utility, the Windows 7 File Recovery tool is a decent option that works much better than the previous Microsoft-made backup solutions that were included with older versions of Windows.

The Windows 7 File Recovery tool is not a replacement for a more robust backup and disk-cloning utility, however. For one, the Windows 7 File Recovery tool doesn't always play well with new hardware, should you need to restore a backup image onto another machine or a machine that's been repaired with newer parts. It also doesn't offer nearly as many options as more feature-rich solutions like Acronis True Image or Symantec System Restore. If you're in a pinch and just want to back up some personal files or create an image of a machine you know won't be altered anytime soon though, the Windows 7 File Recovery tool can certainly get the job done.



Which drives do you want to include in the backup?

The drives that are required for Windows to run will be included by default. You cannot inclu the drive that you are saving the backup to.

Your backups are being saved on Tertiary SSD (E:).

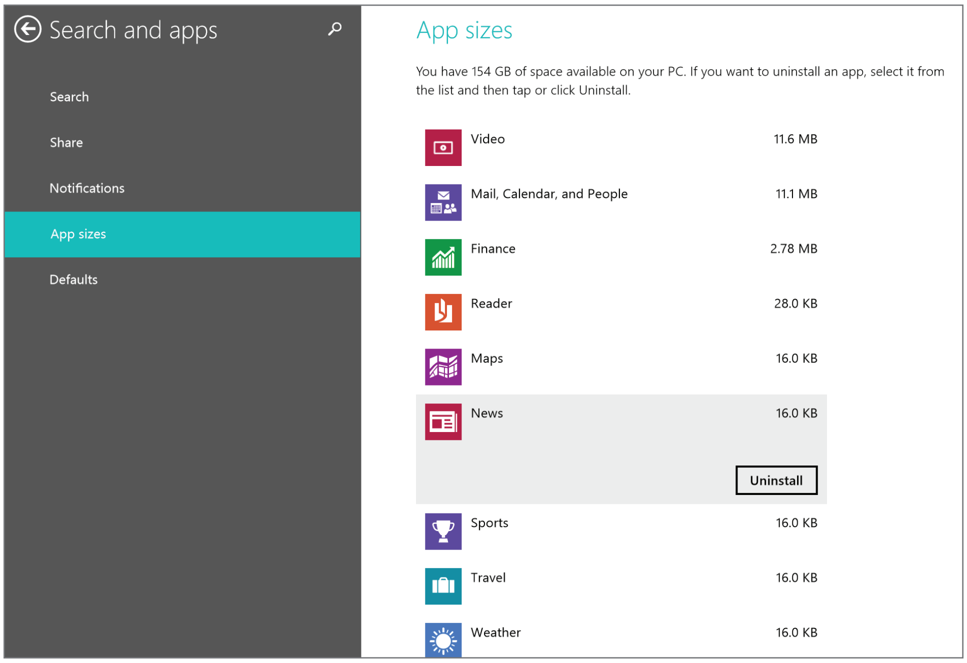
Drive	Total size	Used space
☑ System Reserved (System)	350.00 MB	47.43 MB
☑ Main Volume (RAID 0) (C:) (System)	447.10 GB	83.17 GB
☐ Secondary SSD (D:)	931.17 GB	201.88 GB

Space required to save a backup of the selected drives: 83.21 GB
Space available on Tertiary SSD (E:): 282.19 GB

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH



App sizes

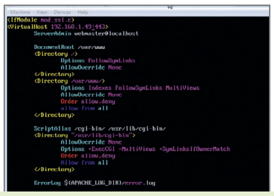
You have 154 GB of space available on your PC. If you want to uninstall an app, select it from the list and then tap or click Uninstall.

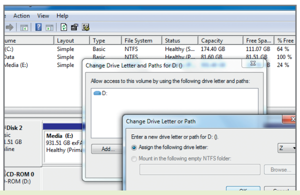
Video	11.6 MB
Mail, Calendar, and People	11.1 MB
Finance	2.78 MB
Reader	28.0 KB
Maps	16.0 KB
News	16.0 KB
Sports	16.0 KB
Travel	16.0 KB
Weather	16.0 KB

FIND SPACE-HOGGING APPS IN WINDOWS 8.1

Running out of disk space in Windows 8.1? You can easily see which of your Windows store apps are taking up too much space. Just open the settings charm, then click Change PC Settings, then Search and Apps, then finally App sizes. You'll see how much space each app is using.

MAKE - USE - CREATE





54
Build Your Own Cloud Server

56
Use Partitions to Keep Your Data Safe

ALEX CASTLE
CONTRIBUTING EDITOR

CRACKING THE LINUX COMMAND LINE

ONE OF THE how-to articles this month talks about installing some software on a Linux computer, a process that gets pretty hairy pretty fast. While I love the promise of Linux, and I've enjoyed trying out a number of distros over the years, it can still be a little bit bewildering. In particular, using the command line—which is absolutely essential for using Linux well—can often seem like black magic. You read complicated commands on online tutorials, copy them over to the console, and pray that you didn't just tell your computer to wipe all your hard drives.

This month, I found a great new tool to make the process a lot less opaque. It's a website called Explainshell.com, and it does just that. You enter any shell command into the search bar, and it provides you with a detailed description explaining exactly what each command and flag does. Try it with some of the commands from this month's how-to, if you're feeling lost.

↘ submit your How To project idea to: comments@maximumpc.com

Build Your Own Cloud Server

YOU'LL NEED THIS

UBUNTU 12.04 SERVER EDITION

ownCloud runs as a service on an existing server. We'll be using Ubuntu on a virtual machine. Download the ISO at www.ubuntu.com/download/server.

OWNCLOUD

We're using the download archive at http://owncloud.org/install.

VIRTUALBOX

For the virtual machine, we'll be using VirtualBox, available at www.virtualbox.org.

BUILD YOUR own castle in the sky and snuggle all of your data into one cozy place. The promise of cloud storage on the Internet has, to a large extent, been delivered. We've got free services of all shapes and sizes, but is this a dream come true or the start of a nightmare?

We're leaning toward the latter, as cloud storage certainly offers an easy way for the government to rifle through your data for no good reason and share its findings with all of its buddy services. Of course, that's without any consent or knowledge from you, because we're all OK with that, right?

But you probable think that building your own cloud storage is a hard, costly, and tiresome endeavor. You would be wrong. An awfully clever group of people have built a system called ownCloud (http://owncloud.org), a web service that's designed to run on most web servers. Getting ownCloud installed does require Linux and a little console action, but once it's up and running, it's largely a web-interface affair.

You may very well be screaming: "Why do we need to run this on Linux and not Windows?" It's an understandable lament, but the reality is that a near-default install of a Linux server comes with a pile of useful web-based tools, protocols, and services. The ownCloud project uses standard web server, PHP, and MySQL services to offer you an easy-to-use cloud system, and without Linux it'd be next to impossible or just very expensive to have it developed. For this tutorial you'll need to download the Ubuntu server ISO from www.ubuntu.com. –**NEIL MOHR**

1

SET UP A VIRTUAL LINUX SERVER To make this less scary, we're going to run it all wrapped up in a virtual machine. We're using VirtualBox from Oracle. If you haven't already, download it from www.virtualbox.org and install it.

» For the Ubuntu server, create a new machine with at least 1GB of memory and add storage of say 100GB for the primary hard drive. You'll need to point the CD optical drive to the Ubuntu Server ISO image you downloaded. We also suggest for the virtual machine that under Network you select a bridged connection (**image A**), as this provides the VM with its own real IP address, making accessing it more straightforward.

» When the VM starts, it will boot the CD ISO and start the installation. You need to create a new root user account. At Partition Disks, select Guided and set up LVM. Remove anything already there and choose to use all but 4GB of the available space. This creates a large work partition and a small swap partition, just in case.

» Don't worry about HTTP proxy, select security updates, and at Software selection, ensure you select OpenSSH server and LAMP server (**image B**). You'll be asked for a new MySQL password—we suggest you use one different from your main user account, but don't forget it! Install the GRUB boot loader and then continue on to the ownCloud installation.

» At this stage you should be logged into the VM at a Linux command prompt. Now we need to add PHP5 and Curl libraries, then download and extract the ownCloud system. This process will involve entering a number of commands, but don't worry—you'll be done soon. Note that the commands below will work for the version of ownCloud that's current as of publication. You can (and should) go to http://owncloud.com and check for a more current download URL.

» Enter the following:

```
Sudo su
apt-get install php5 php5-gd php-xml-parser php5-intl php5-sqlite php5-mysql smbclient curl libcurl3 php5-curl mysql-server
wget http://download.owncloud.org/community/owncloud-5.0.11.tar.bz2
tar xjf owncloud-5.0.11.tar.bz2
mv owncloud/ /var/www/owncloud
```

» Next, we need to make a Data folder and set read/write permissions:

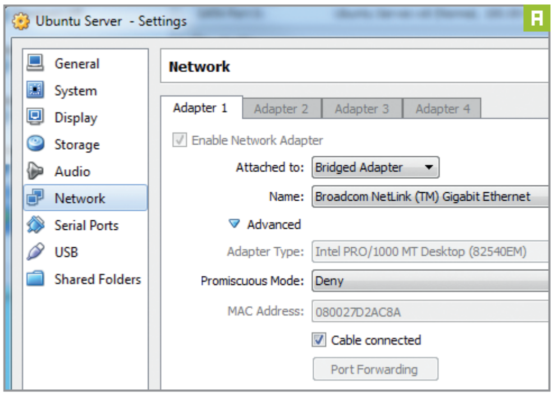
```
mkdir data
chown -R www-data:www-data data
chown -R www-data:www-data config
chown -R www-data:www-data apps
```

» At the terminal, type:

```
sudo vi /etc/apache2/sites-enabled/000-default
```

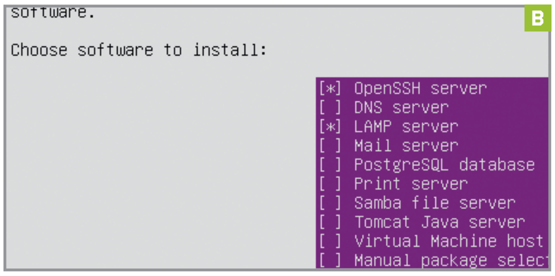
This is the crazy terminal text editor. Press [I] to edit and under the <Directory /var/www/> section, set AllowOverride to All. You'll need to press [Esc] to end editing, then press [W] to write the file and [Q] to quit. Two more useful commands are **sudo a2enmod rewrite** and **sudo a2enmod headers**.

» Lastly, type **service apache2 restart** to make the web server changes live. At this point, you can finish the installation by typing http://<vm.ip.address>/owncloud into a browser's address bar. The final ownCloud page will appear. Use any username and password and click Advanced. Enter **root** as the SQL username, along with the password you chose and a database name such as ownCloud.



A

☑ Enable Network Adapter
Attached to: Bridged Adapter
Name: Broadcom NetLink (TM) Gigabit Ethernet
Adapter Type: Intel PRO/1000 MT Desktop (82540EM)
Promiscuous Mode: Deny
MAC Address: 080027D2AC8A
☑ Cable connected


B

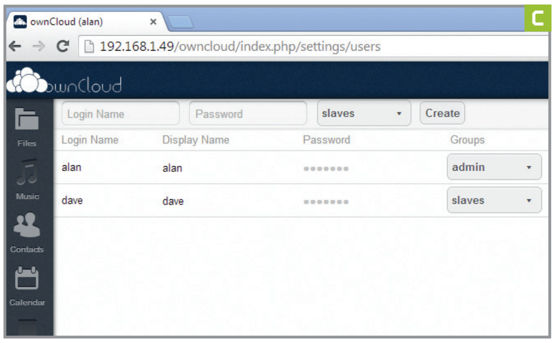
```
software.

Choose software to install:

                              [*] OpenSSH server
                              [ ] DNS server
                              [*] LAMP server
                              [ ] Mail server
                              [ ] PostgreSQL database
                              [ ] Print server
                              [ ] Samba file server
                              [ ] Tomcat Java server
                              [ ] Virtual Machine host
                              [ ] Manual package select
```

2 CONFIGURE OWNCLOUD You're now looking at the main (and rather empty) browser interface (**image C**). You'll see the Settings section is at the top-right of the screen. It contains a number of useful options, so select it and then click Users. This enables you to add, remove, and control account access to the cloud system. Just type a name and password, add a group, and give it a suitable quota.

» OwnCloud enables you to synchronize a whole bunch of stuff with PC, Mac, and Linux systems, including documents, photos, contacts, and calendars. To get started, install the desktop tool from http://owncloud.org/sync-clients. To log in, type http://<vm.server.ip>/owncloud then supply the username and password. The tool will minimize to your notification area.

» The primary use of the desktop app is to sync folders and files to the ownCloud server. You can choose as many folders and files as you like—you'll just need to create unique alias names on the server side of things and let them synchronize (**image D**). Remember to add some MP3s to enable the music player, and do the same for pictures.

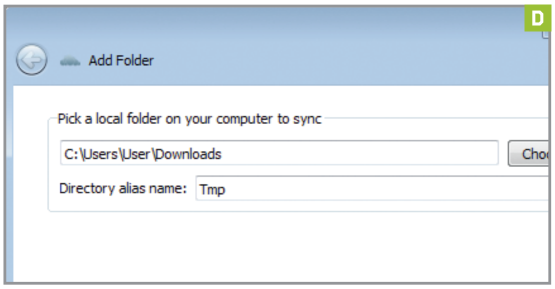
» OwnCloud has mobile apps for both Android and iOS. They're not perfect, as they seem to synchronize the entire folder tree, which can take a while if you have a lot of files. Otherwise, this makes it easy to upload and download files from your ownCloud server. The alternative is to just use the browser interface, which isn't bad at all.


C

ownCloud (alan)

192.168.1.49/owncloud/index.php/settings/users

Login Name	Display Name	Password	Groups
alan	alan	●●●●●●●	admin
dave	dave	●●●●●●●	slaves


D

Pick a local folder on your computer to sync

C:\Users\User\Downloads

Directory alias name: Tmp

3 GAIN SSL SECURITY To secure your server with encryption, you should enable HTTPS access. Back at the console, type the following commands to enable SSL on the Apache server: **sudo su**, then **a2enmod ssl**, and finally,ß **service apache2 restart**. You can then check that the changes are working correctly by typing **netstat -tap | grep https** and make sure the result is set to HTTPS LISTEN.

» The following command copies the default config and launches the terminal editor:

cp /etc/apache2/sites-available/default-ssl /etc/apache2/sites-available/ownCloud-ssl

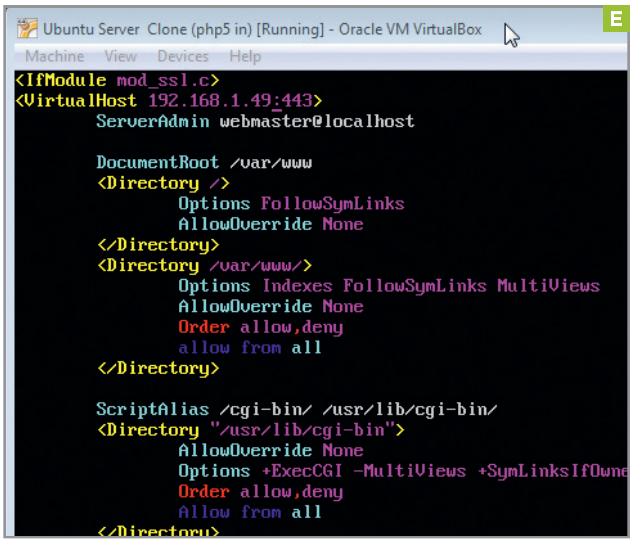
then

vi /etc/apache2/sites-available/ownCloud-ssl

» Press [I] to edit and change the top <VirtualHost xxx:443> line's xxx to your server's IP address (**image E**). Press [Esc] to stop editing.

» Press [W] to save and [Q] to quit. Finally, we have three more commands to make the ownCloud host the default instance: **a2dissite default-ssl**, then **a2ensite ownCloud-ssl**, and **service apache2 reload**. You're now able to log on with the client using https://<vm.ip.address>/owncloud for an encrypted connection. You'll get a certificate warning, which is standard.

» External connections rely on your router to forward the correct ports. You should select a random port between 49152 and 65535—say, 57001, for example. Set the router to forward port 57001 to port 443 at your VM's local network IP address. You can then connect externally to your home broadband's IP like this: https://<broadband.ip>:57001/owncloud.


E

Ubuntu Server Clone (php5 in) [Running] - Oracle VM VirtualBox
Machine
View
Devices
Help

```
<IfModule mod_ssl.c>
<VirtualHost 192.168.1.49:443>
        ServerAdmin webmaster@localhost

        DocumentRoot /var/www
        <Directory />
                Options FollowSymLinks
                AllowOverride None
        </Directory>
        <Directory /var/www/>
                Options Indexes FollowSymLinks MultiViews
                AllowOverride None
                Order allow,deny
                allow from all
        </Directory>

        ScriptAlias /cgi-bin/ /usr/lib/cgi-bin/
        <Directory "/usr/lib/cgi-bin">
                AllowOverride None
                Options +ExecCGI -MultiViews +SymLinksIfOwne
                Order allow,deny
                Allow from all
        </Directory>
```

Use Partitions to Keep Your Data Safe

YOU'LL NEED THIS

A THUMB DRIVE OR OTHER EXTERNAL STORAGE
To hold your documents while you reformat your drive.

WE'VE ALWAYS advocated keeping your docs, files, and other data on a drive that's separate from Windows and your applications. That way if something goes wrong with Windows, your data is more likely to remain safe. It's not always viable to purchase a second internal hard drive for your PC though, which is where partitioning comes in handy.

Partitioning allows you to divide a large hard drive into two or more smaller drives, which Windows will treat as if they were separate physical drives. Of course, a physical defect with the hard drive will affect both partitions, but it will be much more difficult for software-related problems to wipe out your Windows files and your personal documents at the same time.

In this tutorial we'll show you how to divide a single drive into two partitions, then move your data to the new partition so Windows knows where to find it. –**NICK PEERS**

1 **SHRINK YOUR EXISTING HARD DRIVE** Click the File Explorer/Windows Explorer icon in the Taskbar and select Computer from the left-hand menu. Check the free space available for the C drive—remember, this drive needs to be large enough to hold all your data. To get an idea of how much data you have, browse to C:\Users, right-click your username, and choose Properties—you'll now see the amount of space needed to proceed (**image F**).

» If your user folder is larger than the available free space on the C drive, you'll need to move some of its contents to an external hard drive. Open the relevant folder—typically Documents, Pictures, Music, or Video—and move its contents into a folder of the same name on your external drive. Repeat until the size of your user folder is smaller than the drive's free space.

» Windows 8 users should press Windows + X and select Disk Management from the Quick Access menu. For Windows 7 and Vista users, you'll need to click Start, select Run, and type **diskmgmt.msc** into the dialog box, before clicking OK. When the Disk Management window opens, right-click drive C and choose the Shrink Volume... option.

» After a short pause, Windows will display the maximum amount the C drive can be shrunk by (**image G**). If this isn't enough for your purposes, there are a few things you can do to clear up additional room:

> Run disk cleanup

Some temporary files are considered unmovable—running Disk Cleanup may help to shift them and free more available space (**image H**).

> Disable system restore

You'll lose your Restore points, but temporarily disabling System Restore is usually the key to shrinking your C partition further (**image I**).

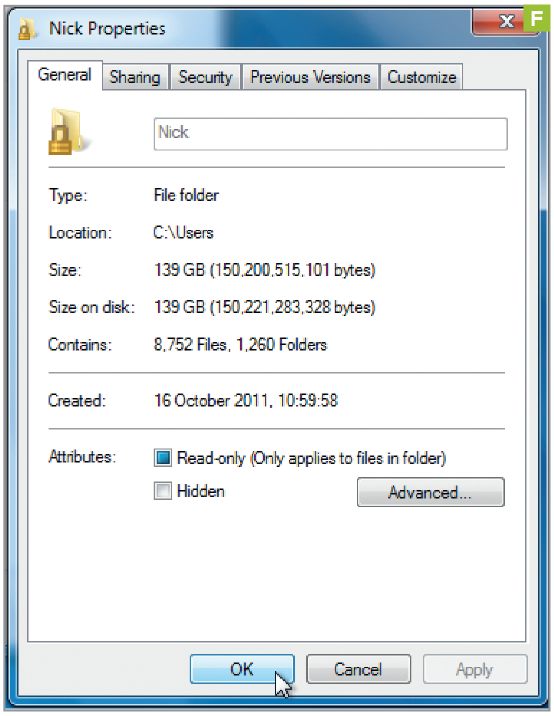
> Use event viewer

Still no luck? Open Event Viewer and select Windows > Applications log. Choose Filter Current Log and type **259** into the All Event IDs box to reveal more unmovable files.

> Reboot

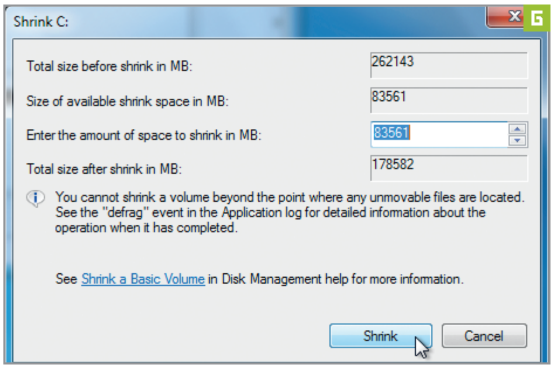
Once you've tried one or more of the above tips, reboot your PC and open Disk Management again to see if you can free up more space for your new data partition.

If the figure is acceptable, click Shrink—if it's too large, enter a different figure in MB.



Nick

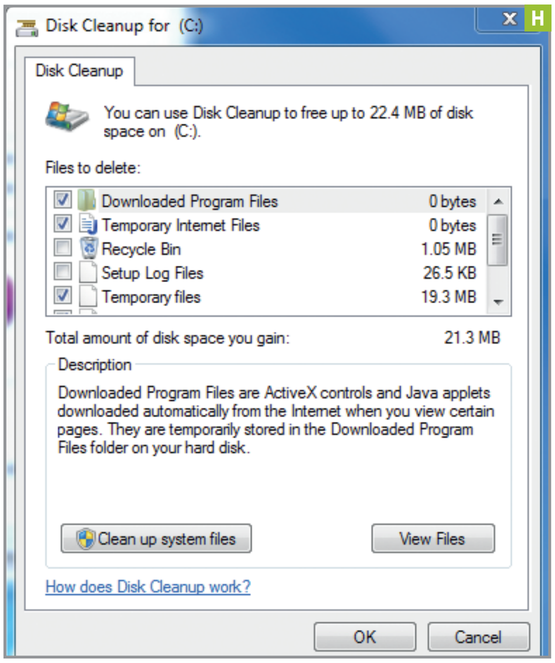
Type: File folder
Location: C:\Users
Size: 139 GB (150,200,515,101 bytes)
Size on disk: 139 GB (150,221,283,328 bytes)
Contains: 8,752 Files, 1,260 Folders
Created: 16 October 2011, 10:59:58
Attributes: ■ Read-only (Only applies to files in folder)
☐ Hidden



Total size before shrink in MB: 262143
Size of available shrink space in MB: 83561
Enter the amount of space to shrink in MB: 83561
Total size after shrink in MB: 178582

You cannot shrink a volume beyond the point where any unmovable files are located. See the "defrag" event in the Application log for detailed information about the operation when it has completed.

See Shrink a Basic Volume in Disk Management help for more information.



Disk Cleanup for (C:)

Disk Cleanup

You can use Disk Cleanup to free up to 22.4 MB of disk space on (C:).

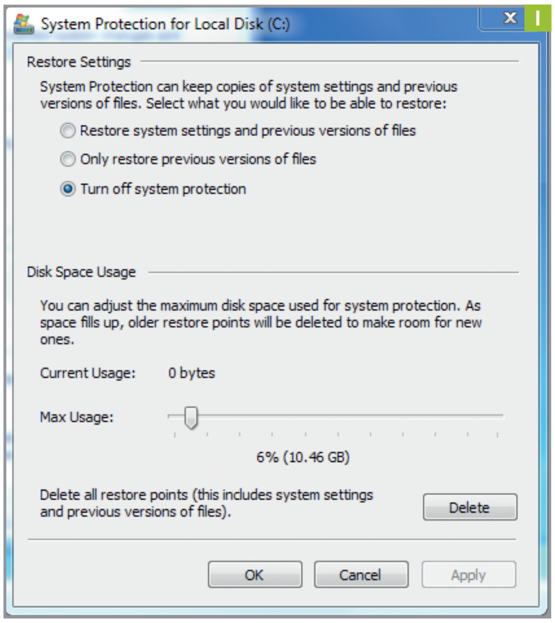
Files to delete:

☑	Downloaded Program Files	0 bytes
☑	Temporary Internet Files	0 bytes
☐	Recycle Bin	1.05 MB
☐	Setup Log Files	26.5 KB
☑	Temporary files	19.3 MB

Total amount of disk space you gain: 21.3 MB

Description

Downloaded Program Files are ActiveX controls and Java applets downloaded automatically from the Internet when you view certain pages. They are temporarily stored in the Downloaded Program Files folder on your hard disk.



System Protection for Local Disk (C:)

Restore Settings

System Protection can keep copies of system settings and previous versions of files. Select what you would like to be able to restore:

○ Restore system settings and previous versions of files
○ Only restore previous versions of files
● Turn off system protection

Disk Space Usage

You can adjust the maximum disk space used for system protection. As space fills up, older restore points will be deleted to make room for new ones.

Current Usage: 0 bytes

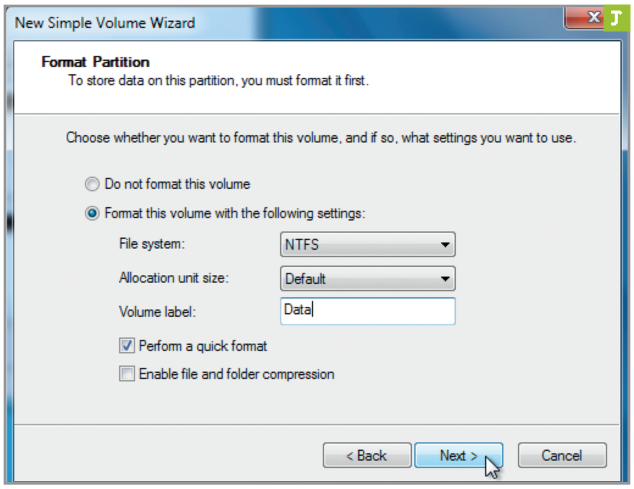
Max Usage: 6% (10.46 GB)

Delete all restore points (this includes system settings and previous versions of files).

2 **CREATE A NEW PARTITION** Now, wait while Windows resizes the drive. When it's complete, you'll see that a new unallocated section will appear next to the drive in the Disk Management window. This will become your new data partition. To set it up, right-click the empty space and choose New Simple Volume.... Now, click Next on the New Simple Volume Wizard.

» When asked to specify the volume size, leave the default figure alone and click Next (**image J**). If you want to assign drive letter D to the new partition, simply select "Do not assign a drive letter or drive path" for now, and click Next. Give the volume a suitable label (such as Data), leave the other options as they appear, and click Next, followed by Finish.

» Locate the drive that's been allocated the D drive letter, then right-click it and choose the "Change Drive Letter and Paths..." option. Now, click Change to pick a new drive letter (such as Z) and click OK (**image K**), followed by Yes. Now, right-click your new data partition and select "Change Drive Letter and Paths..." when you're done. Finally, click Add, select drive D, and click OK.



New Simple Volume Wizard

Format Partition

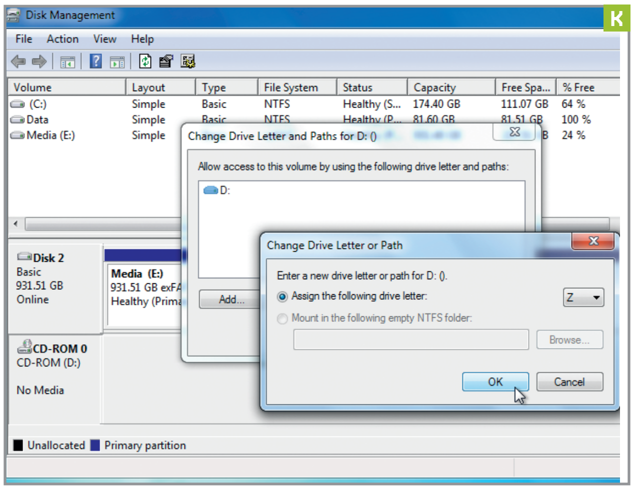
To store data on this partition, you must format it first.

Choose whether you want to format this volume, and if so, what settings you want to use.

○ Do not format this volume
● Format this volume with the following settings:

File system: NTFS
Allocation unit size: Default
Volume label: Data

☑ Perform a quick format
☐ Enable file and folder compression



Volume	Layout	Type	File System	Status	Capacity	Free Spa...	% Free
(C:)	Simple	Basic	NTFS	Healthy (S...	174.40 GB	111.07 GB	64 %
Data	Simple	Basic	NTFS	Healthy (P...	81.60 GB	81.51 GB	100 %
Media (E:)	Simple					B	24 %

Change Drive Letter and Paths for D: ()

Allow access to this volume by using the following drive letter and paths:

D:

Change Drive Letter or Path

Enter a new drive letter or path for D: ().

● Assign the following drive letter: Z
○ Mount in the following empty NTFS folder:

3 **TRANSFER YOUR FILES** Open a folder window and browse to C:\Users\yourusername. Right-click the Documents folder and choose Properties. Switch to the Location tab and click Move. Open your new drive and create a new folder with your username. Create another folder inside it called Documents. With this folder selected, click Select Folder, then choose OK, followed by Yes.

» Once the files have been moved to your data partition, repeat the same process for all the other user folders you need: typically Desktop, Downloads, Pictures, Music, and Videos, but you might also consider using Contacts, Favorites, and Saved Games, too. Once done, transfer any files you moved to your external drive into the relevant folders on your data partition.

» Congratulations, you've set up a data partition on your drive to keep your documents and other files separate from Windows. You can now take a drive image of your Windows partition using the incredibly useful Windows Backup tool (or by using a third-party program, such as Acronis True Image or Macrium Reflect Free) and restore this image in the future without ever having to touch your files. ⏻

BUILD IT

TOM MCNAMARA **ASSOCIATE EDITOR**

Radeon R9 290X in a Shoebox PC

We know the Radeon R9 290X can go head-to-head with a GTX Titan, but can this extra-long, hot-running GPU hang in a small form factor chassis like a Titan can?

LENGTH OF TIME: **2–4 HOURS** | LEVEL OF DIFFICULTY: **MEDIUM**

THE MISSION For a while now, we've considered doing another Build It with a "shoebox" case like the Silverstone Sugo SG08 we used in the June 2013 issue. If you recall, we wedged Nvidia's GeForce GTX Titan into a mini-ITX system, and it provided a surprising amount of firepower to a system that was remarkably small. The Titan is able to hang in a tiny chassis due to Kepler's efficiency, making it highly effective in close quarters. Fast forward to the present, and AMD has released the Radeon R9 290X, which performs about as well as a Titan but costs around $550—nearly half the price. However, the R9 290X runs a bit hot under the collar, typically at 94 C, and is a half-inch longer than the Titan, as well. Though it's certainly competitive with Titan in benchmarks, we wondered whether the R9 290X can withstand the rigors of a small form factor build. To find out, we stuffed it into a new shoebox chassis from Cooler Master, and added a new Corsair closed-loop cooler designed specifically for small enclosures. We added a modular power supply from Seasonic that is also designed for SFF builds, so this should be one badass box

COOLER MASTER

SEEING RED

COOLER MASTER sent us an Elite 120 Advanced Mini-ITX case a while back. It looked intriguing, but we had concerns about the lack of clearance underneath the power supply. The company seemingly read our minds when it produced the sequel, the Elite 130. This one has a recessed 120mm fan mount in the front, and you can slap a radiator on the back of it, with room to spare. There's so much room, in fact, that we decided to crank it to 11 and add a push-pull closed-loop CPU cooler, and Corsair's all-new H75 fit the bill. We'd used several of CM's other liquid coolers at this point, so we were familiar with their designs and we knew they worked well in these small enclosures. The H75 was also a new product as this issue went to press, so we were curious to test it for the first time. Since this is a high-end build with an Intel Core-i7 4770K CPU and a Z87 motherboard, we wanted an appropriately high-grade power supply. We chose Seasonic's "G-Series," which is a gold-rated model, and as you may know, Seasonic also makes well-regarded PSUs for Corsair, Antec, XFX, and NZXT. It also has modular cables, which is a must for a system of this size.

Our motherboard is a Gigabyte Z87N-WIFI, which is fully loaded despite its size, and includes Bluetooth 4.0, dual Gigabit LAN, four USB 3.0 ports, dual-link DVI, and 802.11n Wi-Fi. All four of its SATA ports are SATA 6Gb/s, too. We also grabbed some low-profile Corsair Vengeance RAM, to stay out of the way of our cables.

INGREDIENTS

	PART	PRICE
Case	Cooler Master Elite 130	**$50**
PSU	Seasonic G Series 550W	**$85 (street)**
Mobo	Gigabyte Z87N-WIFI	**$135**
CPU	Intel Core i7-4770K	**$325 (street)**
Cooler	Corsair Hydro H75	**$85**
GPU	AMD Radeon R9 290X	**$550**
RAM	2x 8GB Corsair Vengeance LP	**$160 (street)**
SSD	Seagate 600 240GB	**$190 (street)**
HDD	1TB Western Digital Caviar Black	**$90**
OS	Windows 8.1 64-bit OEM	**$90**
Total		**$1,760**

1 AN AIRTIGHT CASE

IF WE'D GONE with an air cooler in this build, we were pretty much stuck with low-profile units, because the design of the Elite 130 case puts the power supply right above the motherboard. Using a liquid cooler allows us to move the bulk of our CPU cooling system to the front of the case. Since the case's bundled 120mm intake fan sits in a recessed mount, there is enough space when it's removed to use both of the Corsair H75's fans. We just had to keep the tubes on the right-hand side of the case, out of the way of the video card. We needed a flashlight to properly guide the cooler's long bolts through the mounting holes, but installation was painless otherwise.

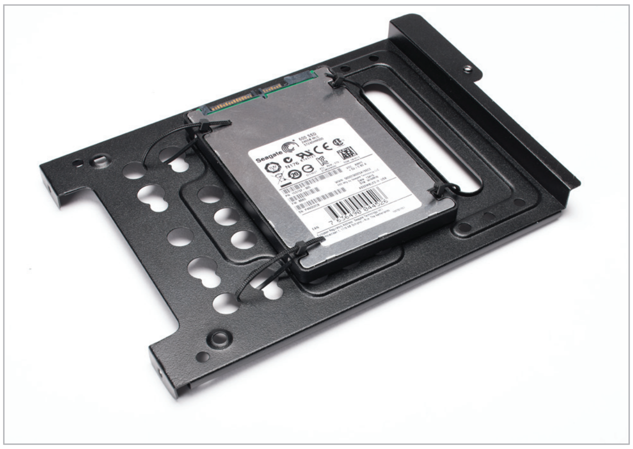
2 IF THE SHOE FITS

WITH ITS "SHOEBOX" style Elite 130 chassis, Cooler Master has embraced builders who want a PC but don't want a stereotypical tower design. It's about 14.5 inches long, 7.5 inches tall, and 9 inches wide, which might sound roomy but is quite compact for all the gear we're stuffing inside of it. On the other hand, Silverstone's SG08 is about one inch smaller on every side, and after building inside that unit, we know we prefer something a little bigger, mainly to make cable routing easier. Cooler Master's case can also fit a full-size optical drive and power supply (and the 5.25-inch bay can be converted to fit a hard drive or a control panel). The Elite 130 also costs $50 instead of the SG08's $200, mostly because it doesn't have that case's custom 600W "bronze" PSU pre-installed. We figured we could get a decent power supply for less than $150, and we succeeded. The Elite 130 also offers several spots to mount SSDs and HDDs, giving us more leeway in how to arrange our cabling.

3

ALL TIED UP

OUR POWER supply's SATA cables terminate at right angles, which is increasingly common these days. Normally this isn't a problem, but since we're using a 3.5-inch drive and a radiator with two fans, we couldn't attach the power supply cable to the SSD given the aforementioned cable angle, so we flipped the drive upside down. There are no screw holes on the top of an SSD, so we threaded zip ties through the holes on the side and bottom, and passed those through the holes in the case. There are no moving parts in an SSD, so there's no risk of data corruption in doing this. We chose a removable side panel for the mounting plate (pictured).



4

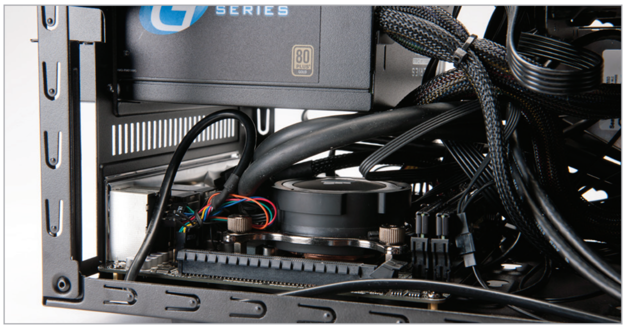
DRESSED TO THE R-NINES

WE'VE SEEN COOLER Master demonstrate this case with a Radeon HD 7990 video card installed, and that guy is 12 inches long. Since AMD's R9 290X is just 11 inches long, we figured there would be no surprises, and we were correct—installing it turned out to be the easiest part of the build. Granted, Seasonic deserves a lot of credit for endowing its PSU with highly flexible and flat PCI Express cables. Conventional rounded and braided PCIe cables would have been a different story. (For reference, the HD 7990 just barely fits; it touches the radiator's chamber, but there's no electricity going through the rad, so it won't cause a short.) The PCIe slot's retention clip is a little tough to reach once the card is installed, but a long screwdriver should do the trick. We threaded the front-panel audio cable underneath the card, since it was already running alongside it toward the rear of the case.

5

ENABLING CABLING

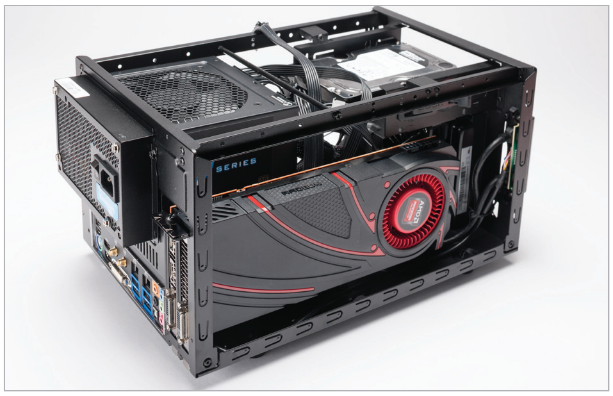
EVEN WITH OUR low-profile cooling installed, you can see that there isn't a lot of room to party underneath the power supply. We had to connect pretty much all the cabling first, then slide in the PSU. The USB 3.0 cable was thankfully bendable enough, and the fan headers, SATA ports, and front-panel connectors are all positioned within easy reach. The system comes with a 60mm fan that installs in the back-right of the case, but we left it out because we were already using the motherboard's two fan headers for the Corsair H75. Since this video card ejects almost all of its heat outside of the case, and the power supply is drawing in air through a mesh grill in the top, we weren't worried about heat buildup. (The video card would ordinarily block this entire shot, so we took it out temporarily.) Since we had just two storage devices and one video card, we didn't expect things to get too messy. Still, we put a chrome grill on the H75's internal fan, to prevent snags. You can pick up a similar grill for a few bucks online or at your local computer store.

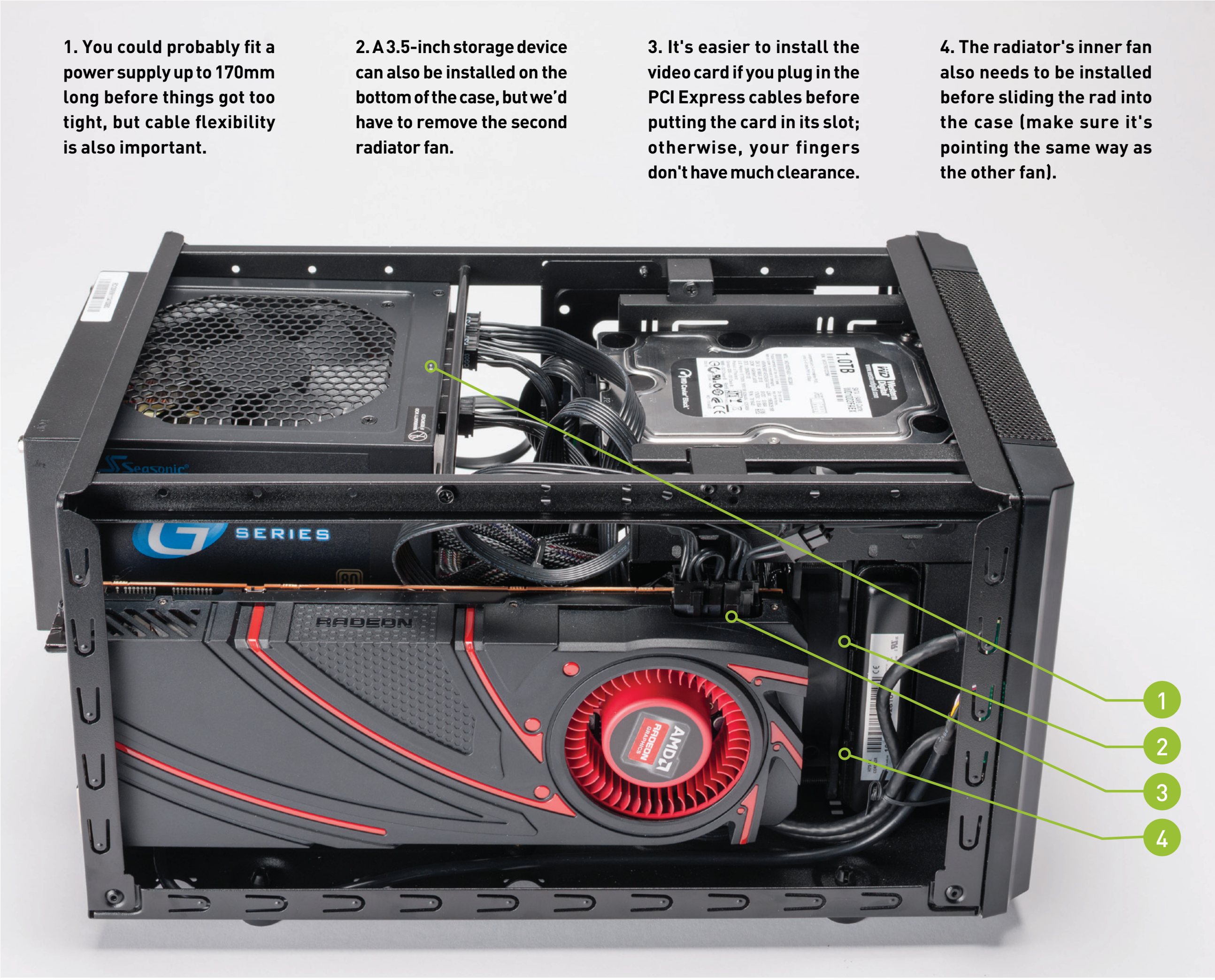


6

SEASONIC BOOM

YOU PROBABLY noticed the boxy area that extends from the back of the case. This compartment gives builders additional space to use standard-size power supplies. Our Seasonic unit is 160mm long and the box gave us plenty of room on the other end to manage its modular cables. The box is attached with four screws, so you take those out, slap the box on the back of the power supply, screw the box onto the power supply (using a different set of holes), then re-install the box on the back of the case. There's a large meshed grill above this area for ventilation, so the PSU went in upside-down to take advantage of that as an intake. This PSU is not fully modular, so the 24-pin and 8-pin power cables are permanently attached. We snaked those through first and tucked their spare length in the space in front of the CPU cooler. Because we had the SSD and HDD located close to each other, we were able to use just one SATA power cable to connect both storage devices. This PSU even comes with a short SATA power cable with two connectors on it, so it was like PB&J.





1. You could probably fit a power supply up to 170mm long before things got too tight, but cable flexibility is also important.

2. A 3.5-inch storage device can also be installed on the bottom of the case, but we'd have to remove the second radiator fan.

3. It's easier to install the video card if you plug in the PCI Express cables before putting the card in its slot; otherwise, your fingers don't have much clearance.

4. The radiator's inner fan also needs to be installed before sliding the rad into the case (make sure it's pointing the same way as the other fan).

BETTER OFF RED?

THE SYSTEM idled very quietly, partly because it has no case fans. We were able to get the Core i7-4770K up to a stable 4.4GHz just by increasing the Turbo clock ratio and increasing the core voltage in the UEFI. Mouse tracking in the UEFI was really laggy though, and keyboard navigation was a bit unclear, so we switched to "Classic" mode and used the keyboard instead. Prime95's CPU torture test got the CPU up to 80 C, but it ran much cooler during the other benchmarks, rarely going over 70 degrees. The Hydro H75 was also very quiet. When it's idling, you basically have to put your ear up against the front of the case to even hear air circulating through it. It doesn't integrate with Corsair's Link software, but there's something to be said for the simplicity of UEFI controls. It also makes the cabling simpler; just attach the fans to the bundled splitter cable, and attach the splitter to the CPU fan header. The pump plugs into any spare case fan header.

The Radeon R9 290X hits 94 C at its stock "quiet mode" setting and begins to throttle the GPU's core clock, so there was no overclocking to be done. It wasn't any noisier than usual in this case since there's a large grill on the side that acts as an intake for cool exterior air. We let it loop the Heaven 4.0 benchmark overnight, and it was still running when we came back the next morning. When the GPU was cranked up to full speed, you could definitely hear it above the background noise of the office, but it wasn't bothersome.

Overall, this system was surprisingly non-tedious to put together despite its compact dimensions and high-end parts. Its small size also made it easy to move around and fiddle with. All in all, we must say this is one killer little rig. If you're looking for a water-cooled, quiet-yet-extremely powerful SFF machine, you can't do much better than this build, unless you go with a bigger case and budget.

BENCHMARKS

	ZERO POINT	
Premiere Pro CS6 (sec)	2,000	2,296 (-12.9%)
Stitch.Efx 2.0 (sec)	831	734
ProShow Producer 5.0 (sec)	1,446	1,264
x264 HD 5.0 (fps)	21.1	19
Batman: Arkham City (fps)	76	76
3DMark11 Extreme	5,847	4,585 (-21.6%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

The zero-point machine compared here consists of a 3.2GHz Core i7-3930K and 16GB of Corsair DDR3/1600 on an Asus P9X79 Deluxe motherboard. It has a GeForce GTX 690, a Corsair Neutron GTX SSD, and 64-bit Windows 7 Professional.

REVIEWS

TESTED. REVIEWED. VERDICTIZED.

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EVGA
CYBERPOWERPC
intel inside CORE i7

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Maybe we should call this a macro-tower?

ASRock
EVGA
XFast RAM
GEFORCE GTX 780
EVGA
HYDRO COPPER

CyberPower Hadron Hydro 400

The birth of a new form factor

FORM FACTORS are never easy to define. For example, where's the line between a mid-tower and a full-tower? And how do you define small form factor?

Amid all this confusion, we thought we had at least defined what a micro-tower is: a thin and powerful PC with discrete graphics, such as the Falcon Northwest Tiki or Digital Storm Bolt. Easy, right?

Wrong. CyberPower bends the definition with its new Hadron Hydro 400. At first glance, it looks like a micro-tower, but upon closer examination, you think, no, it's not quite a micro-tower because it's too wide, right? The box certainly isn't as big as, say, the micro-ATX-based V3 Devastator that we reviewed in our Holiday 2013 issue. So, just what the frak is it? Maybe, as Senior Editor Josh Norem suggested, it's a "macro-tower"—the bigger cousin to a micro-tower.

There's indeed an advantage to the just-a-bit-wider-than-a-micro-tower form factor. Every micro-tower we've seen is limited to air cooling or closed-loop cooling of the CPU only. The GPU, arguably the hottest part in the case, has to go it on air cooling alone. With the slightly wider Hadron, CyberPower is able to add a slick, miniaturized custom-cooling loop that keeps both the CPU and GPU cool. The rad isn't some small jobbie, either, but a full-on dual-fan radiator mounted in the top. To make full use of the space, the system actually snakes liquid out through the back of the case and into the top using a very trick-looking set of chrome hard tubes. The fans are mounted under the rad in a push configuration, which vents hot air out the grill top.

A full-on custom-cooling loop solves another issue we've see in micro-towers: noise. When enough hardware is pushed to the max in a micro-tower, it gets loud. The fastest micro-tower we've ever tested is Falcon's Tiki, which we reviewed in our November issue. That box pushed the acoustic envelope, although its Haswell was also overclocked to an insane 4.7GHz.

The Core i7-4770K in the CyberPower Hadron seems conservative at 4.2GHz, but the custom loop also absorbs the thermals from an EVGA Hydro Copper 2 GTX 780 card. Even under the heaviest loads, the system never got terribly loud. It's not silent by a long shot, but it's certainly quieter than most micro-towers when pushed hard.

In performance, the Hadron represents well against the micro-towers we've tested. On the CPU side, it's tied with or faster than all but the Falcon Northwest Tiki from our November 2013 roundup. Its liquid-cooled and overclocked GTX 780 outpaces or ties the micro-towers' GPUs, as well. The Hadron also outruns the V3 Devastator we reviewed in our Holiday 2013 issue in all CPU-related tasks, but loses badly against the V3's SLI'd GeForce GTX 770s. There's just no way a single GeForce GTX 780 can manhandle SLI cards. That's also why the CyberPower Hadron gets lumped up by our zero-point's GeForce GTX 690 and its hexa-core processor.

In the price-to-performance calculator, the CyberPower Hadron does OK, coming in at $2,300. Its closest competitor is the iBuypower Revolt from our November 2013 roundup, which cost $2,000—with a GeForce Titan. The V3 Devastator also offers a nice package at $2,500, although that box is definitely bigger and only gives you a Core i5 part.

We should give the CyberPower Hadron its due respect, though—we've come to expect small boxes to run on air or off-the-shelf liquid coolers and that's just not true anymore. This is a sexy little number.

–**GORDON MAH UNG**

VERDICT
9

CyberPower Hadron Hydro 400

⊞ **HYDRO POWER** Custom liquid cooling; small; fairly quiet.

⊟ **HYDRO CARBONS** What, no 780 Ti? Not intended to run horizontally.

$2,260, www.cypberpowerpc.com

BENCHMARKS

	ZERO POINT	
Premiere Pro CS6 (sec)	2,000	2,358 (-15%)
Stitch.Efx 2.0 (sec)	831	772
ProShow Producer 5.0 (sec)	1,446	1,303
x264 HD 5.0 (fps)	21.1	18.4 (-13%)
Batman: Arkham City (fps)	76	74 (-3%)
3DMark 11	5,847	5,078 (-13%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

SPECIFICATIONS

Processor	Intel Core i7-4770K @ 4.2Ghz
Mobo	B85M-ITX
RAM	16GB DDR3/1866
Graphics	EVGA GeForce GTX 780 Hydro Copper 2
Storage	2x 128GB Samsung 840
Optical	24x EVGA DVD burner
Case/PSU	EVGA Hadron Hydro 400 / EVGA 500 watts

The ultra-fancy WindForce cooler sports anti-turbulence inclined fans, copper heat pipes, and vapor chambers.

Gigabyte GTX 780 Ti OC

A 'Force' to be reckoned with

THE GIGABYTE GTX 780 Ti OC Edition is somewhat like a *Maximum PC* editor, in that it is powerful and mostly silent. This is the OC Edition we are testing, so it's in a high state of tune right out of the box, thanks to a colossal "WindForce" cooler that can expel up to 450W of heat—it's almost overkill on this 250W TDP GPU. Keep in mind we are big fans of overkill, though, particularly when this package costs exactly the same amount of money as the reference board. So, yes, you get all this cooling and overclocking for *free*.

With all that cooling headroom, Gigabyte has increased the clock speeds on this sucker from the stock 875MHz to 1,020MHz, with its boost clock also increased from 928MHz to 1,085MHz. Since the 780 Ti's memory is already running at 7GHz, Gigabyte left that untouched, so it remains at stock speeds. At press time the card should be bundled with three top games, but the deal is only "while supplies last," so check with Gigabyte or the retailer during purchase for the bundle.

To test the Gigabyte GTX 780 Ti, we put it up against the reference board from Nvidia, the $1,000 GTX Titan, the $650 Asus Mars 760, and the $550 AMD R9 290X. Since this is the first retail GTX 780 Ti we have tested, we expected it to break some benchmark records. And no surprise, it was the fastest GPU in every test we have, except in Far Cry 3 and Crysis 3 where it lost to the dual-GPU Asus Mars 760 by one lousy frame per second—effectively a tie. We were impressed by how much faster it was than the stock card, too—typically by around 10 percent—which, we will remind you, costs the same.

The Gigabyte GTX 780 Ti overclocking performance was also respectable, but not as good as what we saw with the reference card from Nvidia. That card boosted up to 1,241MHz, but the Gigabyte card topped out at 1,176MHz. Under load, the Gigabyte card performed extremely well, hitting just 82 C and running totally silent at all times. The stock cooler hit around 85 C when overclocked and was quite loud. Clearly, the WindForce design reaps benefits both in acoustics and performance.

With only the reference board to compare it to, along with the less expensive Radeon R9 290X, it's impossible to say whether the Gigabyte is the "best" 780 Ti, but it's damn good, and we can't imagine how another vendor's card would be any better at the same price. We can see a card maybe outperforming it by one or two percent, and having better software, but it won't beat this one on price and certainly not on acoustics. **–JOSH NOREM**

BENCHMARKS

	Gigabyte GTX 780 Ti OC	**GTX 780 Ti (Reference)**	**GTX Titan**	**AMD Radeon R9 290X (Quiet)**	**Asus Mars 760**
Driver	331.82	331.82	331.82	13.11 Beta 9.2	311.82
3DMark Fire Strike	**10,472**	9,953	9,159	9,638	9,488
Unigine Heaven 4.0 (fps)	**44**	39	36	33	37
Batman: Arkham Origins (fps)	**61**	51	46	53	54
Crysis 3 (fps)	32	28	26	30	**33**
Far Cry 3 (fps)	46	41	39	33	**47**
Tomb Raider (fps)	**33**	27	25	29	30
Metro: Last Light (fps)	**27**	23	21	17	25
Battlefield 4 (fps)	**56**	47	42	44	49
CoD: Ghosts (fps)	**61**	60	48	45	57

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P9X79 motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8. All games are run at 2560x1600 with 4X AA except for the 3DMark tests.

VERDICT
9
KICK ASS!

Gigabyte GTX 780 Ti OC

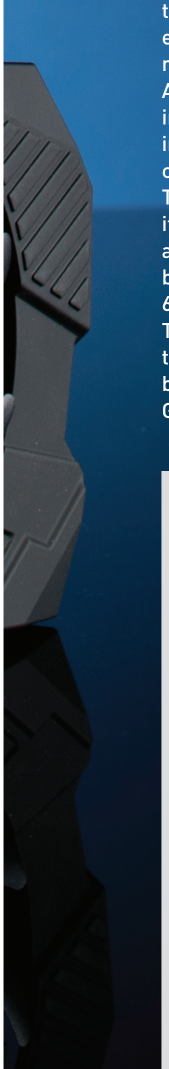
MUTT Fastest GPU in the Lab; very quiet; perfect price.

PUREBRED OC Guru software is meh; not the highest overclocker.

$700, www.gigabyte.us

There is a Mars logo on the side that lights up and "breathes" during operation.

REPUBLIC OF GAMERS



Asus Mars 760

A superb GPU, but there's little reason to buy it

WE'VE OFTEN wondered why dual-GPU video cards always use two flagship GPUs instead of something a bit more midrange. Sure, we get the whole "most powerful card in the world" marketing tagline that inevitably follows the creation of cards with two high-end GPUs, but those suckers are expensive, run really hot, and oftentimes require exotic cooling. Well, this month Asus has answered our question by packing two midrange GeForce GTX 760 GPUs into one PCB, creating a $650 dual-GPU card designed to take on the $1,000 GTX Titan and the $700 GTX 780 Ti. We figured it would be potent before we even put it on a test bench, since in our "Tested!" feature back in October 2013 we found dual GTX 660 Ti cards to be faster than a GTX 780. Therefore, it's not a stretch to imagine that two GTX 760s could be faster than a Titan, but since people aren't that into the dual-GPU thing these days, this will have to be one stupid-fast card to make us believers.

To recap, the GTX 760 uses a GPU named GK104 that is considered midrange nowadays, but in 2012 was found in the flagship GTX 680 card. The two GPUs aren't exactly the same though, as the GTX 760 chip is in a slightly milder state of tune, with just 1,152 CUDA cores (the original GTX 680 had 1,536 cores). The GTX 680 was also clocked a bit higher than the GTX 760, but Asus has made up for that by clocking the Mars 760 at the same clock speed as the original GTX 680, which is extremely high by today's standards, at 1,006MHz with a 1,072MHz boost clock. Each GPU in the Mars has 2GB of RAM clocked at 6GHz, and it operates over a 256-bit interface. The board uses a custom PCB that is 11 inches long and has 12-phase power, but takes up only two PCIe slots. Asus has qualified this board for external SLI, so you could theoretically hook up two of these bad muthas for quad-SLI if you have the bankroll.

In testing, the Mars 760 was indeed one of the fastest GPUs we've ever benchmarked, besting the more-expensive GTX Titan and GTX 780 Ti as well, but failing to dethrone the almighty GTX 690. In every test, it was basically neck-and-neck with the GTX 780 Ti, putting the Mars 760 right up there with the fastest of Nvidia's arsenal, so kudos to Asus on that. In addition to its top-shelf performance, it was exceptionally quiet and cool, never rising above 80 C under load, even when overclocked to 1,215MHz. According to our records, this also makes it one of the coolest-running high-end GPUs we've tested recently, as the GTX 780 Ti runs at about 82 C, and the R9 290X runs at 94 C.

There's clearly a lot to like here, but there are also two big problems. First, the GTX 760 SLI can be purchased for $500 or less, making this card too expensive. Second, since it's on par with the GTX 780 Ti, we imagine most people will just want that card since you don't have to hassle with SLI. Overall, the Mars 760 is excellent, but nobody was asking for a card like this for Nvidia users, and its price is a bit tough to swallow, so maybe there's a reason few have taken this route. –**JOSH NOREM**

BENCHMARKS

	Asus Mars 760	GTX 780 Ti (Reference)	GTX Titan	AMD Radeon R9 290X (Quiet)	GTX 690
3DMark Fire Strike	9,488	9,953	9,159	9,638	**10,478**
Unigine Heaven 4.0 (fps)	37	39	36	33	**42**
Batman: Arkham Origins (fps)	54	51	46	53	**72**
Crysis 3 (fps)	33	28	26	30	**37**
Far Cry 3 (fps)	47	41	39	33	**56**
Tomb Raider (fps)	**30**	27	25	29	29
Metro: Last Light (fps)	25	23	21	17	**27**
Battlefield 4 (fps)	49	47	42	44	**61**
CoD: Ghosts (fps)	57	60	48	45	**80**

Best scores are bolded. Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an Asus Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8. All games are run at 2560x1600 with 4X AA except for the 3DMark tests.

VERDICT

8

Asus Mars 760

+ MARS Righteous performance; cool and quiet; two slots.

− URANUS Too expensive; only a tiny bit faster than single-GPU cards.

$650, http://rog.asus.com

The 240L's copper block comes polished to a mirror shine.

Breaking the Cold Mold

Two CPU coolers combine forces in different ways

Closed-loop liquid coolers (CLCs) have a number of advantages for enthusiasts. They can overclock higher than an air cooler but they don't require the expense, fiddling, or maintenance of a full-on custom loop. However, there hasn't been a lot of variety in the basic design lately. So today, we're taking a look at two CLCs that have broken from the herd. Cooler Master is working with Swiftech, which usually makes parts for custom loops, and Antec is putting its pump on the fans itself. –TOM MCNAMARA

COOLER MASTER GLACER 240L

At first glance, the Glacer 240L is very similar to Swiftech's H220. This time, though, it sports two 120mm Cooler Master Blademaster fans, a beefier PWM pump, and a different cabling setup. Asetek sued Swiftech last year, alleging that the H220 infringed on some of its patents, and Swiftech pulled the product from US shelves; this collaboration with Cooler Master apparently allows them to stay in the game.

The 240L (named so because it sports a 240mm radiator) still has the H220's distinctively thick and shiny PVC tubes, which you can still detach using a Philips screwdriver. Technically it's a semi-closed loop since once you've detached it from the water block you break the seal on it. One tank on the radiator includes a fill port to top it off after you've detached it.

The LGA1150 backplate actually came pre-attached out-of-the-box, so it took a couple of minutes of tweaking to remove that. Since our test bed is LGA2011, we also had to replace the spring-loaded screws with another set included in the box. These are fixed to the bracket with tiny plastic clips that took some wrangling to get off. We'd recommend pliers. Overall, installation was more fiddly than usual, but it was actually the cabling that provided the biggest obstacle.

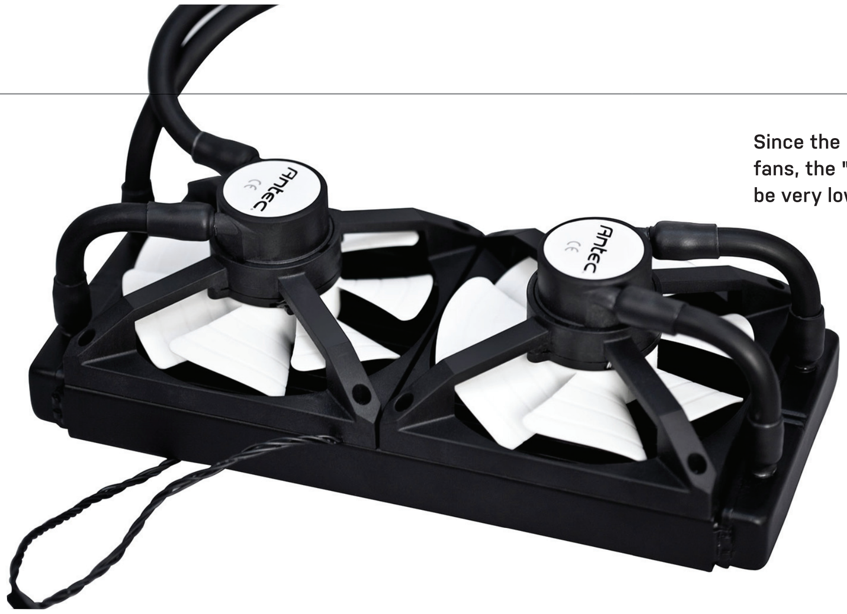
There's no splitter cable in the box to combine the two fan cables into one. Normally, the fans get a splitter to plug into the CPU fan header. The SATA cable for powering the pump is straightforward enough. But the pump also has a 4-pin cable for PWM control—does that go into the CPU fan header, too? The documentation offers no guidance. Standard ATX motherboards max out at two fan headers that are actually designed to handle PWM hardware: They're usually labeled CPU Fan and CPU OPT, the latter of which is used for a second CPU fan. We had to scrounge a splitter cable from another company's kit to plug both fans into the board's CPU OPT.

On the bright side, once you've conquered the installation phase, the cooling is excellent. In fact, the Glacer 240L is right up there with the Kraken X60, despite the latter having 280mm of surface area to work with. Then again, the X60 frequently gets down to $110, and the similarly performing Corsair H100i gets even lower. Both also have noticeably better noise levels, mostly because their pumps are much smaller. But the $140 price tag on the Glacer 240L still takes some convincing. How much do you value being able to replace the individual components and the coolant itself, or being able to expand the loop to add a video card, using standard G1/4 fittings? As the basis for a full-system loop, the Glacer 240L is practically a bargain. But if you just want to cool your CPU, there are more budget-friendly options out there, with smoother installation experiences.

VERDICT 9

Cooler Master Glacer 240L

$140, www.coolermaster-usa.com



Since the H20 1250's pumps are on the fans, the "cold plate" over the CPU can be very low-profile.

ANTEC KUHLER H20 1250

CLCs look so similar these days that you usually have to install and benchmark them to detect differences in design and performance. Antec's Kuhler H20 1250, meanwhile, doesn't even need to be taken out of the box. You might ask, "What are those huge knobs on top of the fans?" Those aren't knobs. Those are the pumps. Yes, interestingly, Antec has chosen to integrate the motors that drive the fan and pumps into one. Why, we're not sure, but there's something to be said for symmetry.

On the other hand, the 1250 is one of the easiest installs that we've experienced. The fans come pre-installed, with their cables pre-attached to a splitter that's already plugged into the heatsink that sits on the CPU (which Antec refers to as a "cold plate"). There are two more cables coming out of the heatsink. One is a basic 3-pin job to provide power to the fans and pumps, and the other is an internal USB cable that allows you to control the fans through Antec's bundled Grid software. This is a basic application providing speed presets, temperature, and fan-speed data and graphs. The cold plate also has an LED on top whose color and behavior you can customize. You won't find Grid on Antec's website, though, so if you lose the bundled installation CD, you might be in trouble. This was a pretty new product as this issue went to press, so that issue may be resolved by the time you read this.

The biggest downside to this unit is the sheer real estate it requires. A standard radiator is 25mm thick, as is a case fan. That's about two inches total. The Kuhler 1250 needs about 3.5 inches, though the extra bulk is mostly centered on the pumps sitting on top of the fan motors. We had no problem in our test bed, but we chose its Corsair 900D case primarily for its cavernous interior. The 1250's effective thickness is bigger than a radiator with one fan on each side, so if that wouldn't fit in your case, this probably won't either. We couldn't fit it into two different mid-tower cases; it bumped into the heatsinks around the CPU tray. Antec does not have a compatibility chart, so sizing would have to be tested on a (pardon the pun) case-by-case basis. Since that's not very practical, this is effectively a cooler for a full-tower or super-tower ATX case (especially if you have any plans to add a second set of fans on the other side of the radiator). And you may still encounter physical obstructions.

The 1250 has excellent performance and acceptable noise levels, fortunately. It's right in line with premium CLCs such as the NZXT Kraken X60 and the Corsair Hydro H100i. It even has a solid three-year warranty. But with the pumps integrated into the fans, you can never replace or upgrade the fans. If they are damaged at some point, or if they wear down after the warranty expires, you have to replace the whole kit. When you consider both the lack of flexibility and the huge physical footprint, it's difficult to recommend the Kuhler 1250 over the competition.

SPECIFICATIONS

	Cooler Master Glacer 240L	Antec Kuhler H20 1250
Radiator Dimensions (H x D x W)	1.14 x 10.6 x 5 inches	1.1 x 11 x 4.7 inches
Stock Fans	2x 12cm PWM	2x 12cm PWM
Socket Support	LGA1150/1155/1156/1366/2011; AM2/AM2+/AM3/AM3+/FM1/FM2/939	LGA775/1150/1155/1156/1366/2011; AM2/AM2+/AM3/AM3+/FM1/FM2
Additional Fan Support	2x 12cm	2x 12cm

BENCHMARKS

	Glacer 240L Quiet / Performance Mode	Kuhler H20 1250 Quiet / Performance Mode	Kraken X60 Quiet / Performance Mode	H100i Quiet / Performance Mode
Ambient Air	22.7 / 23.2	24 / 22.5	20.9 / 20.7	20.3 / 20.5
Idle Temperature	33.7 / 29.5	35.8 / 31.7	29.7 / 28.8	30.7 / 29.3
Load Temperature	67.2 / 62.8	69.3 / 63.3	66 / 61.8	67.1 / 61
Load - Ambient	**44.5 / 39.6**	45.3 / 40.8	45.1 / 41.1	46.8 / 40.5
Price	$140	$120 (street)	$120 (street)	$110 (street)

All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard, in a Corsair 900D with stock fans set to Standard.

VERDICT 7

Antec Kuhler H20 1250

$120 (street), www.antec.com

BMW's design group actually worked on the M8's look and feel.

ASRock
Tue
15:04
12/10/2013

Asrock M8

Behold: The DIY micro-tower has finally arrived

WE'LL BE HONEST. We've been green with envy over micro-tower boxes. Alienware's X51 first kicked off the party and since then, Falcon Northwest, Digital Storm, and iBuypower have followed suit.

That's fine and dandy for buyers of nicely crafted PCs, but what about the DIYer who likes to roll her own? Well, your time has finally come in Asrock's new M8 tower.

The company has been known primarily as the cost-conscious option for enthusiasts, but there's more to it than that. While Asrock's motherboards have always been pretty budget, the company also is known to push the edge, giving you eyebrow-raising features at its eyebrow-raising prices.

The M8 is an example of this. At 14.5 inches deep, 4.8 inches wide, and 15.5 inches tall, this micro-tower is similar to iBuypower's Revolt. That means it's definitely larger than Alienware's X51, as well as the two other micro-towers in the world: Falcon Northwest's Tiki and Digital Storm's Bolt.

The Asrock M8 isn't just a chassis, though—it's a bare-bones build. That means the micro-tower chassis comes with an Asrock Z87-M8 Mini-ITX board, a 450-watt SFX PSU, and a slim-line optical drive.

To get the M8 up and running, all you need to do is bring an LGA1150 CPU, some SO-DIMM RAM, and storage. If you want to play any real games, you also need to slot in a discrete GPU.

The two main parts we want to dish about are the motherboard and the chassis. The motherboard is a standard Mini-ITX board, but apparently made just for the M8. We were initially turned off by the use of SO-DIMMs rather than DIMMs, but there is a trade-off to be made when you use the longer DIMMs in board space. The Z87-M8 features a full set of SATA 6Gb/s ports right where the full-size DIMMs would have gone. We can't say getting six SATA ports is impossible with desktop DIMM slots, but it certainly would be more of a challenge. We'll also note that this is no bare-bones, strippo motherboard. It features Creative Labs' Core 3D audio with an amp designed to drive fat cans, an integrated mini PCIe 802.11AC/Bluetooth 4.0 card, a full-featured UEFI, and, since it's Z87, it will support overclocking, too. The board also features a compelling set of utilities for updating and fan control that we recommend you not skip.

The chassis itself is quite interesting. Asrock worked with BMW's Designworks-USA on its looks. Externally, it's easy on the eyes, and its aluminum doors and embedded handles give it a nice touch of class. The center of the chassis is mostly plastic and steel, though. In an interesting trick, both doors are held on with neodymium magnets that clamp on pretty well. There's also a key to lock the doors in place, but we had issues with that because the latch kept getting stuck—on wires that had bunched underneath the lock, we think.

Another nice touch is the BMW-like circular controller that lets you scroll between various systems settings. The knob doubles as a display with an integrated orange OLED that shows system info such as clock speed or the time and date.

The two trickiest elements in modern micro-towers are the storage options and the graphic options. Alienware's X51, for example, is limited to a single 3.5-inch HDD that can be swapped out for a pair of 2.5-inch drives. It's been a limitation of the smaller chassis that we've long harped on. There's no such constraint in the M8. Although a bit of a brain bender, the chassis lets you sandwich up to four 2.5-inch drives into a drive tray. If you need magnetic storage, you can actually reconfigure the 2.5-inch tray to hold a single 3.5-tray. If you still want your SSD, a fifth 2.5-tray is tucked under the PSU. It's not fun to get in there, but at least you have the option.

Our biggest complaint with building into the system was adding the GPU. First: The M8 will take a GPU with the max dimensions of 11.5x5.4x1.7 inches—so most single-GPU cards—and we were able to easily put a GeForce 780 Ti card into the space. Our issue was with the metal tray the card slides into. You have to remove both it and the top of the case to access the drive cage, but when trying to put the GPU tray back into the machine, we could not hit the exact position to screw it into place. We tried multiple angles and reseating, but it took brute force to get it back in. Is it us, is it our unit, or is it a design issues? We don't know, but we haven't seen any other complaints online about such a problem, so take it for what it's worth. It certainly requires more work than other micro-towers we've seen, except for maybe the Bolt.

To test the unit, we grabbed a few parts to see how it would run. This included a Core i5-4670K, 16GB of DDR3/1600, a pair of 120GB Corsair Neutron drives, and a GeForce GTX 780 Ti reference card. For the record, Asrock says the M8 is rated for GPUs with max TDP of 200 watts. We intentionally went over that limit with the GeForce GTX 780 Ti's 250-watt TDP to see if the M8 could hack it. We then looped 3DMark overnight twice to see if it would melt. We didn't see any issues but we suppose a full load of SSDs or an actual mechanical drive might add to the stress. If we did stick with a sub-200W GPU though, our options on the high-end are limited. The GeForce GTX 770 is 230 watts and the Radeon R9 280X is 250 watts, so the best AMD card you could use would be the Radeon R9 270X at 180 watts or a GeForce GTX 760 at 170 watts, according to the recommendations. Again, we ran our 250-watt GeForce GTX 780 Ti with no issues, but that's not the same as running it for eight months through a blazing summer. Ideally, it would be nice if Asrock had a 500-watt PSU option on the M8.

The other issue for the M8 is that, despite its size, there is no option for liquid cooling. There's simply no place to put the cooler since the cover has no vent. We ran an Intel stock cooler in our build, and there are low-profile, more efficient coolers, but with such limited space, your overclock won't get crazy. The liquid-cooled Falcon Northwest Tiki, for example, pushed its Haswell part up to 4.7GHz.

So, where does that leave us? The M8 is imperfect. It could use a bigger PSU and more cooling, and the GPU tray, on our unit at least, was a pain. But it's also a good value, performance-oriented, and let's face it: Beggars can't really be choosey. We've been groveling for months for a DIY solution, and this is as close as you can get today. **–GORDON MAH UNG**

VERDICT 8

Asrock M8

➕ **BMW M5** Reasonably priced; the only game in town for a DIY micro-tower.

➖ **M5 COMPUTER** PSU is undersized for big cards; GPU tray is a little finicky.

$450 (street), www.asrock.com

Asus PQ321Q

4K has arrived!

THIRTY INCHES. 2560X1600 resolution. Four million pixels. That *was* the gold standard in PC displays, but it's just been blown away. Welcome to the wonderful world of ultra-high-definition visuals. With this outrageous $3,500 flat screen, Asus is giving us our first taste of 4K resolutions. It might just be the next big thing in PC graphics. Can it possibly live up to the hype?

Maybe. The PQ321Q is the largest true PC monitor we've seen, at 31.5 inches diagonal, and it's also the most expensive, at $3,500. It's therefore tricky to immediately take the Asus PQ321Q seriously. If you're the kind of person fed up with $600 GPUs, what are you supposed to make of a $3,500 monitor? Here's the thing: This panel is so exceptional, so spectacular, that it demands your attention at any price.

The big news, of course, is the 3840x2160 resolution. Strictly speaking, it's not quite 4K (or 4,000 horizontal pixels), but it's close enough not to make a material difference to the viewing experience. It's made possible by indium gallium zinc oxide (IGZO) technology, which takes the place of amorphous silicon in standard TFT LCD panels and allows for smaller pixels, while maintaining light transmission. In other words, you can have really high resolutions without losing brightness.

Anyway, it's precisely four times the resolution of a 1080p full-HD panel. To understand how much real estate that is, take a 1920x1080 grid and superimpose it top left on the Asus's 3840x2160 grid. It'll stretch halfway across and halfway down. Then stick another 1920x1080 on the right. You've covered half the screen. Add two more below, and bang—four 1080p grids and four times the resolution.

Advanced mathematics aside, what follows is all manner of goodness. First is general sharpness and image quality. You may be used to seeing high DPI and tight pixel pitches on you mobile devices, but experiencing it on a screen of this scale is truly spectacular.

Admittedly, mobile devices still trump the Asus PQ321Q in sheer pixel density. The Asus sports pixels measuring 0.182mm across, whereas even the low-res iPhone 5's pixels are less than half as big—just 0.07815mm across—but the initial impression is still of staggering clarity and sharpness, the likes of which you've never seen before in a desktop display.

Next up is screen real estate—a metric ton of it. We're accustomed to using 2560x1440 27-inchers and 2560x1600 30-inchers. But this thing blows them away. Yup, somebody has finally come up with a panel that makes those existing high-res panels feel cramped. The inherent quality of the panel is outrageously good, too. If you've been wondering why not many monitor-makers bother with PVA tech these days, this panel comes along and gives that oft-overlooked panel type a much needed shot in the arm. It matches or bests the top panels out there for contrast, viewing angles, saturation, and black levels, for starters. Then it blows them away with far superior color accuracy and zippy response, free from overdrive-related nasties such as inverse ghosting. It's also worth noting that there's not a whiff of IPS glow and the anti-glare coating is smooth and sparkle-free.

Our next port of call is video quality. What's really interesting here is that high-definition video is typically pegged at 1,920 by 1,080 pixels. That's currently Full HD, and it's what all our brains are tuned to, so when you fire up some 4K content (there are demo streams on YouTube, among other sources), the results are spectacular.

It genuinely feels like looking through a window into an alternative reality—one that's as sharp as the real world, but brighter and more vibrant. Move over stereoscopic 3D; this is where it's at.

When it comes to games, however, the step up isn't quite so dramatic. The reason for that, of course, is that we're accustomed to seeing games rendered at true 2560x1440 or 2560x1600 on similar-size panels. At 3840x2160, the Asus PQ321Q does look tangibly better—it's nothing less than superb—but if you're used to today's beyond-1080p panels, it's not quite a life-altering improvement.

The bottom line is that the Asus PQ321Q looks utterly sublime, but there are issues, and we're not just talking about the 3,500 problems denominated in US dollars. The first is the monumental load that 3840x2160 pixels puts on a graphics chip. Do the math and we are talking about an excess of 8 million pixels on this panel. Ideally, you'd want those pixels updated at a rate of at least 30 times a second—preferably twice as fast. Net result? Your GPU has to process and then pump out roughly 250 million pixels per second. It's a number that's almost beyond comprehension, and it says a lot about modern graphics tech that it's actually doable with a single GPU such as a GeForce GTX 780 Ti or Radeon R9 290X. What you really want to know is: Can you get playable frame rates at super-high settings? The answer is: It's borderline. You should really expect to run multi-GPU setups for this resolution.

The final problem is more of a generic question of 2D support for such a huge resolution. It's beyond what DVI can handle, even in dual-link format, so that's out. A single HDMI connection, using the latest spec, can handle the 3840x2160 resolution, but only at 30Hz refresh. Take it from us, 30Hz is fugly. You need to run this panel at 60Hz.

In theory, you can drive it at 60Hz using dual-HDMI connections, but real-world support for that configuration seems patchy. Thus, your main option is DisplayPort. You'll still need to run the display in what's known as multi-stream mode (MST), rather than single-stream mode (SST).

The technicalities are a bit complicated, but MST boils down to a halfway house between a true single pixel grid and running the screen as a pair of virtual displays.

The key thing with MST is that it shows up as one display to the operating system and applications—most critically, games. The problem is that it's not fully compatible with rendering prior to graphics-driver loading. That means things such as BIOS screens, Windows Safe Mode, and all that jazz. Your mileage will vary depending on the video card. With some, the screen is blank during boot. With others, you'll get the BIOS squished into one half of the display, which is at least usable.

The bottom line is, you'll have to switch modes in the PQ321Q's OSD to guarantee you're seeing things correctly outside of a fully drivered-up Windows OS, which you won't enjoy doing because the OSD controls are placed carefully to make them almost impossible to use comfortably.

This is the new de facto measure for all other screens. OK, hardly anyone will buy this screen, and we do wonder why it's so expensive (the first 30-inch 2560x1600 panels were half this price when they appeared around eight years ago), but for the time being, this monitor is as good as it gets. Well, until someone cooks up a lovely 4K 120Hz panel, that is.

–JEREMY LAIRD

VERDICT 9

Asus PQ321Q

REEL-TO-REEL Superb color accuracy and response; insane resolution.

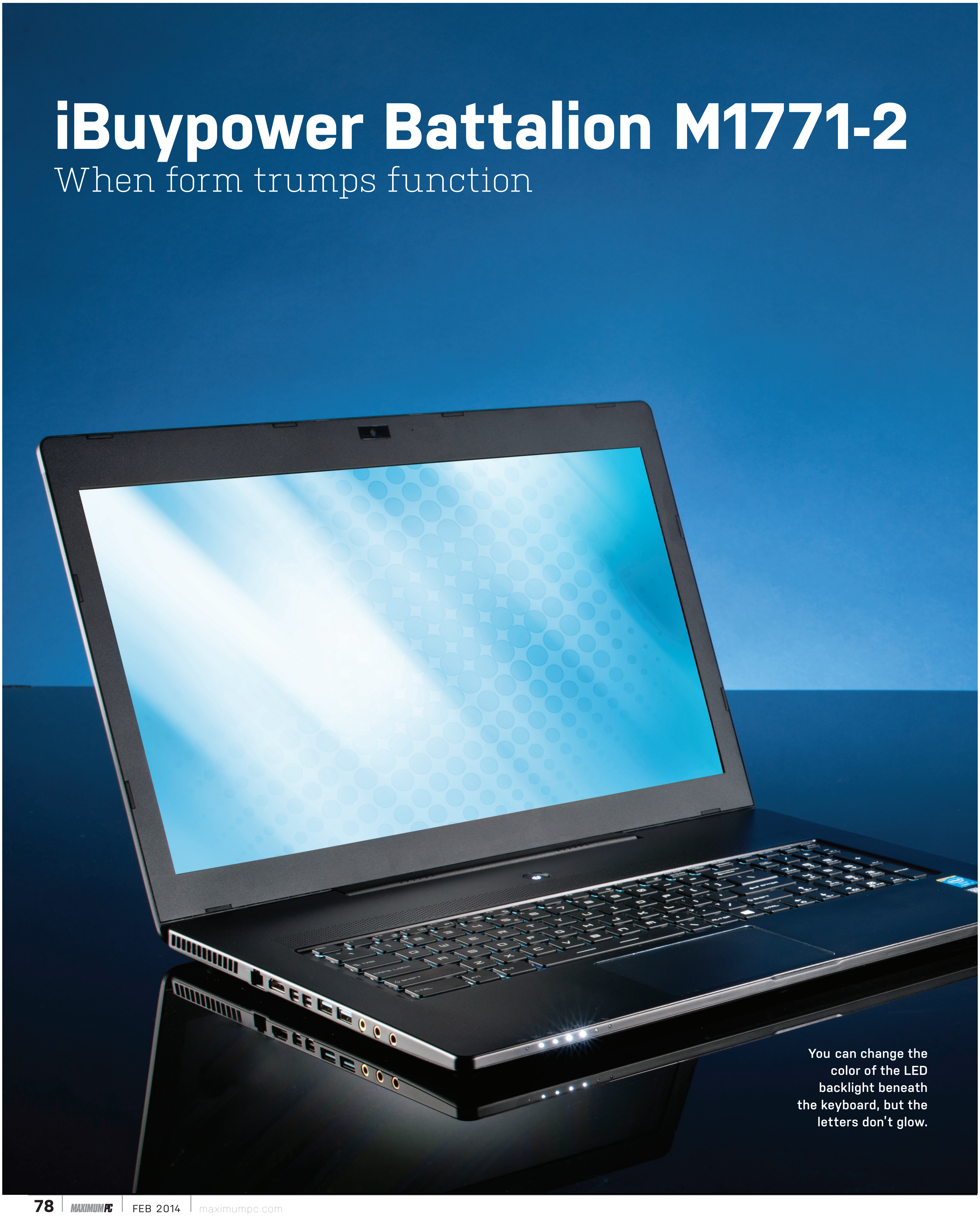
8-TRACK Expensive; can be touchy with how you connect to your GPU.

$3,500, www.asus.com

You might recognize the PQ321Q from our Dream Machine 2013. It's *that* special.

iBuypower Battalion M1771-2

When form trumps function



You can change the color of the LED backlight beneath the keyboard, but the letters don't glow.

IT'S REALLY NO SURPRISE that most 17-inch gaming laptops are back-breakers. Large screens generally equate to large chassis, and beefy, enthusiast components just add to the bulk. But iBuypower obliterates that trend with the Battalion M1771-2—but not without a few trade-offs.

The relatively portable form factor really is the star of the show here. While the 16.4x11.2-inch laptop can consume a lot of desk space, the M1771-2 is mind-bogglingly thin at .85 inches, which makes it .3 inches thinner than the already-amazingly slim 14-inch Razer Blade that we reviewed in July. The M1771-2 is also impressively light for its class, weighing five pounds, 15.4 ounces, which is nearly half a pound lighter than even our "smaller" 14-inch Alienware 14 zero-point. Sexier still is the fact that the power brick is relatively compact, weighing less than 1.5 pounds (most gaming notebook chargers easily weigh more than two pounds).

Truth be told, the M1771-2 is actually *eerily* similar to Razer's sexy 17-inch laptop that we reviewed in our Holiday 2012 issue. Although it's not quite as eye-catching as Razer's offering, the M1771-2 is made of the same sleek black metal, but features a full-size keyboard with number pad in lieu of Razer's Switchblade UI. While you can change the color of the keyboard's LED backlighting, the lighting itself is rather dim. Also, the logo on the back of the M1771-2's display gets the sticker treatment, unlike the sweet-looking LED logo on the 17-inch Razer Blade.

Like the Razer, the M1771-2 lacks an optical drive, but it outdoes the Razer by offering a fourth USB 3.0 port, an SD card reader, and two Mini DisplayPorts. We didn't think it was possible to cram so many features into such a slim laptop. Color us impressed.

All in all, however, the notebook is quite average. The M1771-2 uses a 17.3-inch 1920x1080-resolution TN display, and though the viewing angles aren't bad for a TN panel, we've seen much better from the likes of Maingear's Nomad 15 (reviewed February 2013). And, of course, it can't compare to the viewing angles and color accuracy offered by an IPS panel.

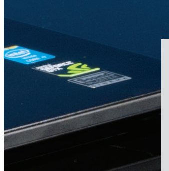
We also weren't blown away by the laptop's speakers, as we thought they could use a bit more volume for noisy environments. The M1771-2's Elan touchpad is serviceable and we like that it features multitouch gestures for two-finger scrolling, but you'll definitely want to tweak the sensitivity settings. Furthermore, we would have preferred two separate physical buttons as opposed to having both integrated beneath the trackpad, so as to avoid any swiping and clicking confusion. The keyboard features chiclet keys that feel sturdy enough, but we do wish the buttons were a smidgen bigger given the large surface area that's available.

Tucked compactly within the chassis is a quad-core 2.4GHz Core i7-4700HQ, 16GB of DDR3/1600, and a GeForce GTX 765M with 2GB of GDDR5. Aside from the Alienware 14's Core i7-4700MQ processor, which falters ever so slightly in the integrated-graphics department, both the M1771-2 and our zero-point carry the same core components.

Despite being equipped with very similar CPUs on paper, however, the M1771-2 lagged behind in our ProShow Producer and Stitch processor tests by roughly 5–8 percent. iBuypower's notebook was even slower in the multithread-heavy x264 HD 5.0 benchmark, falling behind by 10 percent. We suspect the thinner chassis can't dissipate the heat as well as the Alienware, so the processor runs on Turbo Boost just a bit less. However, the iBuypower did fare better in our graphics tests. It was a wash in BioShock Infinite and 3DMark 11, but the M1771-2 was able to best our ZP laptop by 4 percent in Metro: Last Light. In our experiential gameplay tests of Battlefield 4 at its high preset settings and Call of Duty: Ghosts on its highest "extra" settings, both games garnered average frame rates in the high 30s at 1920x1080 resolution. While the games are playable, we recommend tweaking the settings a bit for a smoother experience.

We don't have any kind words to say about the laptop's battery life, unfortunately. iBuypower says that you should be able to squeeze three to six hours of juice out of the 6-cell 5400mAh battery, but we achieved a meager two and a half hours in our video-rundown test. We don't normally harp on battery life too much for gaming laptops because they're often desktop replacements, but considering how relatively portable the M1771-2 actually is, its small battery is an unfortunate quality. In this case, we wouldn't mind a few additional ounces in exchange for a beefier battery that's guaranteed for at least three hours.

Although the M1771-2 cuts some corners with its parts and peripherals, its large screen and super-svelte form factor make it fairly priced at $1,860. It's not a perfect laptop by any means, but if you want a portable gaming laptop with a large screen that doesn't break the bank, you won't find a better option at the moment. **–JIMMY THANG**



BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	962	1,054 (-8.7%)
ProShow Producer 5 (sec)	1,629	1,716 (-5.1%)
x264 HD 5.0	13.5	12.1 (-10.4%)
BioShock Infinite (fps)	36.1	36.6
Metro Last Light (fps)	30.4	31.6
3DMark 11 Perf	4,170	4114 (-1.3%)
Battery Life (min)	234	143 (-38.9%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point notebook is an Alienware 14 with a 2.4GHz Intel Core i7-4700MQ, 16GB DDR3/1600, 256GB mSATA SSD, 750GB 5,400rpm HDD, a GeForce GTX 765M, and Windows 7 Home Premium 64-bit. BioShock Infinite tested at 1920x1080 at Ultra DX11 settings; Metro Last Light tested at 1920x1080 at DX11 medium quality settings with PhysX disabled.

VERDICT 8

iBuypower Battalion M1771-2

➕ **IBUYPOWER** Thin and portable; sleek design; good amount of ports for its class.

➖ **ISELLPOWER:** Poor battery life; TN panel; average peripherals.

$1,860, www.ibuypower.com

SPECIFICATIONS

CPU	2.4GHz Intel Core i7-4700HQ
RAM	16GB DDR3/1600
Chipset	Intel HM87
GPU	Nvidia GeForce GTX 765M
Display	17.3-inch, 1920x1080 TN display
Storage	1TB HDD (7,200rpm), 256GB SSD
Connectivity	Ethernet, HDMI, 2x Mini DisplayPort, media card reader, 4x USB 3.0, mic input, headphone input, mic/headphone input, 2MP webcam, Bluetooth 4.0, 802.11n
Lap / Carry	5 lbs, 15.4 oz / 7 lbs, 4.1 oz

Lenovo Yoga Tablet 8

What a difference a bulbous edge makes

Thanks to its cylindrical battery, the Yoga Tablet 8 could loop 1080p video for four hours and still have 75 percent of its juice remaining.

YOU GOTTA HAND it to Lenovo. The company has figured out a way to make an Android tablet that's easily distinguishable from the plethora of other Android tablets on the market—and has simultaneously opened our eyes to a new tablet form factor that we didn't even know we were looking for, but which makes perfect sense. If only it had performance to match.

Bearing the Lenovo moniker that has come to signify flexibility, the Yoga Tablet 8 (as well as its big brother, the Yoga Tablet 10), features a uniquely bulbous edge on its otherwise flat, thin body. It's a daring move, to be sure, adding even a modicum of bulk to a device in which thinner-and-lighter are the order of the day. But that edge adds functionality that conventional tablets can't match. For starters, it makes it infinitely easier to hold the device with one hand when in portrait mode. With other tablets, a one-handed hold means either a tenuous grip along one edge, with your thumb likely overlapping the screen, or holding the device from the back (if its size permits) with fingers gripping either edge, and both scenarios are apt to induce cramping. Holding the Yoga 8 feels natural and comfortable.

That unconventional edge is also home to a hinge, so a thin metal plate that's flush with the back of the tablet can flip down to form a kickstand that holds the tablet upright on a surface, and the screen can then recline to various degrees. Or flip the screen around so the kickstand is at the top, for yet another viewing angle (pictured). The cylindrical edge also stores a larger battery than is possible in a uniformly thin device, which contributes to the Yoga 8's excellent battery life.

And make no mistake, the Yoga 8 is still plenty thin, with the rest of the slightly wedged slate measuring .12–.29 inches and its total weight coming in at .88 pounds. It also looks nice, with matte-silver metal on the edges and a metal-and-polycarbonate back. We also like the front-facing speakers on the Yoga 8's rounded edge. A nice large power button resides on the on the left end of the rounded edge, with a MicroUSB port right above it. On the other end is an audio jack, with a volume rocker above that.

So far, so good. But here's where things get dicey. At $250, the Yoga 8 costs $20 more than a Nexus 7 with 16GB of storage, but has notably inferior specs. We're talking a 1.2GHz Cortex A7-based proc vs. a 1.5GHz Cortex A15-based one; PowerVR SGX 544MP graphics vs. Adreno 320; and 1GB of RAM vs. 2GB. The practical upshot is evident in the benchmarks, where the Nexus 7 schools the Yoga 8 in everything but onboard storage "disk" performance. When you then consider that the Yoga 8 has a 1280x800 screen compared to the Nexus 7's 1920x1200 res, and features a custom Lenovo-skinned Android 4.2 OS instead of the Nexus 7's native 4.4 Kit Kat, suddenly the Yoga 8's innovative form factor doesn't quite cut it. Performance matters, after all. Now, if we could just have a mash-up of the Yoga 8 and Nexus 7, we'd be happy.

–KATHERINE STEVENSON

VERDICT 7

Lenovo Yoga Tablet 8

HERO POSE Built-in stand; grip-able edge; front-facing speakers; great battery life.

CORPSE POSE Unimpressive components; 1280x800 screen.

$250, www.lenovo.com

BENCHMARKS

	Yoga Tablet 8	Nexus 7
AnTuTu	13,457	**20,386**
Geekbench 3 single-core/multi-core	326/1,089	**580/1,855**
3DMark Ice Storm Extreme	1,527	**7,583**
MobileXPRT Performance	93	**151**
Google Octane	1,748	**2,665**
AndroBench Seq. Read/Write (MB/s)	**62.79/21.2**	56.32/16.34
AndroBench Random Read/Write (MB/s)	**13.7/.78**	11.36/.72
% battery after 4-hour video loop	**75**	65

Best scores are bolded.

SPECIFICATIONS

OS	Android Jelly Bean 4.2.2
Processor	1.2GHz ARM MTK 8125 quad core
Memory	1GB LP DDR2
Screen	8-inch, 1280x800 IPS
Storage	16GB eMMC (expandable by additional 64GB via MicroSD slot)
Cameras	5MP rear, 1.6MP front
Connectivity	802.11n, Bluetooth 4.0, 3.5mm audio jack, MicroSD, Micro USB
Weight	.88 pounds
Dimensions (H x W x D)	8.39 x 5.67 x .12–.75 inches

Microsoft Surface 2

Though improved, Microsoft's ARM tablet still falls flat

WHEN YOU'RE literally the laughing stock of the tablet world, it's pretty hard to make a comeback. In fact, most critics didn't believe we'd see what's before your eyes now: Surface 2.

There's plenty of reason for people to be such haters, too. The original Surface RT that shipped in October 2012 was a financial bomb at its original price of $500. Microsoft eventually had to take a $900 million write-off on the Surface RT; irate shareholders even sued the company, calling SurfRT an "unmitigated disaster."

The reception to Windows RT has been so poor in general, that most of the original PC OEMs who jumped in have since jumped out in favor of full x86-Windows 8.1 tablets. That brings us to the curious life of Surface 2, a sequel to a tablet that most think didn't deserve one.

Externally, the Surf2 looks the same, but the internals are quite different. Surf2 sports a 1.7GHz Tegra 4, which is a good clip faster than the 1.3GHz Tegra 3 in its predecessor. The original wasn't a horrible performer but it did get a bit laggy on occasion. Surface 2 is noticeably faster in feel and in the tests.

To compare performance, we updated the Surface 2 and Surface RT to the latest OS versions and ran browser-based benchmarks within Internet Explorer 11. The Surface 2 was at a minimum twice as fast as the older tablet in the HTML5 tests we ran. There is a cost for this performance, though. Even though Surface 2 is rated to offer longer battery life, we found that Surface RT outlasted Surface 2 by a healthy margin. Our test, admittedly, puts more of a load on a tablet than typical usage. Rather than loop a movie, we looped Futuremark's Peacekeeper HTML5 benchmark, which is a good processor load and keeps the Wi-Fi hot. Surface 2 ran nearly four hours while Surface RT hit an impressive six-plus hours. Surface 2 also got noticeably warm during the rundown.

Other improvements to Surf2 include a 1920x1080-res screen, USB 3.0 support, and low-power capability on the Bluetooth 4.0 radio. The most noticeable physical change is a two-position kickstand, as the kickstand on Surface RT was apparently taken from the Gitmo enhanced-interrogation-techniques manual of PC use and was horribly uncomfortable to use at a desk or on a plane.

The OS is, of course, Windows RT 8.1, and no discussion of the OS can go without talking about its app store. When Surface RT launched, people gave Microsoft the benefit of the doubt that the app market would pick up. It hasn't. The app market still looks and feels like the store shelves following a zombie apocalypse, where you'd drop to your knees and thank the gods for a can of beans.

Perhaps even worse for the app market is the lack of support from Google. We know each of the big companies are building their own self-contained biodomes but they're also increasingly trying to cut each other out too, and the lack of a Modern app for Gmail, Google Maps, and all things Google really, really hurts the Surface 2. Yes, there's a Netflix app, Amazon app, and Yahoo native app, but the inability to get Gmail or Google Maps or YouTube makes the Surface 2 an inferior experience to Android-based tablets. The fact that Google deigns to support iOS makes it doubly bad for those of us who want finger-friendly apps on our tablets.

The only real plus on the software side is the free copy of Office 2013 that's optimized for ARM on the Surface 2. With it, you get Word, Excel, PowerPoint, OneNote, and Outlook. Those apps give the Surface 2 its only real edge over other tablets. With the TypePad 2 keyboard attached (the original TypePad is actually better) and a Bluetooth mouse, you can get away with a decent amount of laptop-like Office productivity that you really can't with other tablets. And no, we don't care what you say—that copy of SquareOfficePro12 you downloaded from the app store for $4.99 will not do absolutely everything Microsoft Office will do. It just can't and won't. It may do what *you* need it for, but it won't do the same things as a set of applications that Microsoft has thousands of people working on, so stop fooling yourself.

So, where does this leave Surface 2? It's clearly superior to the original Surface RT in performance, but it doesn't really matter. Even the original Surface RT had issues with fratricide in our eyes and the situation is far worse for Surface 2. Who, after all, wants to pay for Surface RT or Surface 2 when you can get a full x86-based Windows 8.1 tablet for almost the same price that will at least run Windows desktop apps? Frankly, not many of us, as you can see from the sales figures.

–GORDON MAH UNG

BENCHMARK

	Surface 2	Surface RT
Sunspider 0.91 (ms)	**463.8**	954.2
Google Octane V2	**3,273**	1,234
RoboHornet	**44.78**	28.42
Kraken (ms)	**10,267**	24,129
Futuremark Peace Keeper	**740**	415
Wirple	50	**71**
Multi-Tasking Load with Kraken (ms)	**17,855**	31,961
Battery Rundown (min)	229	**372**

Best scores are bolded.

VERDICT

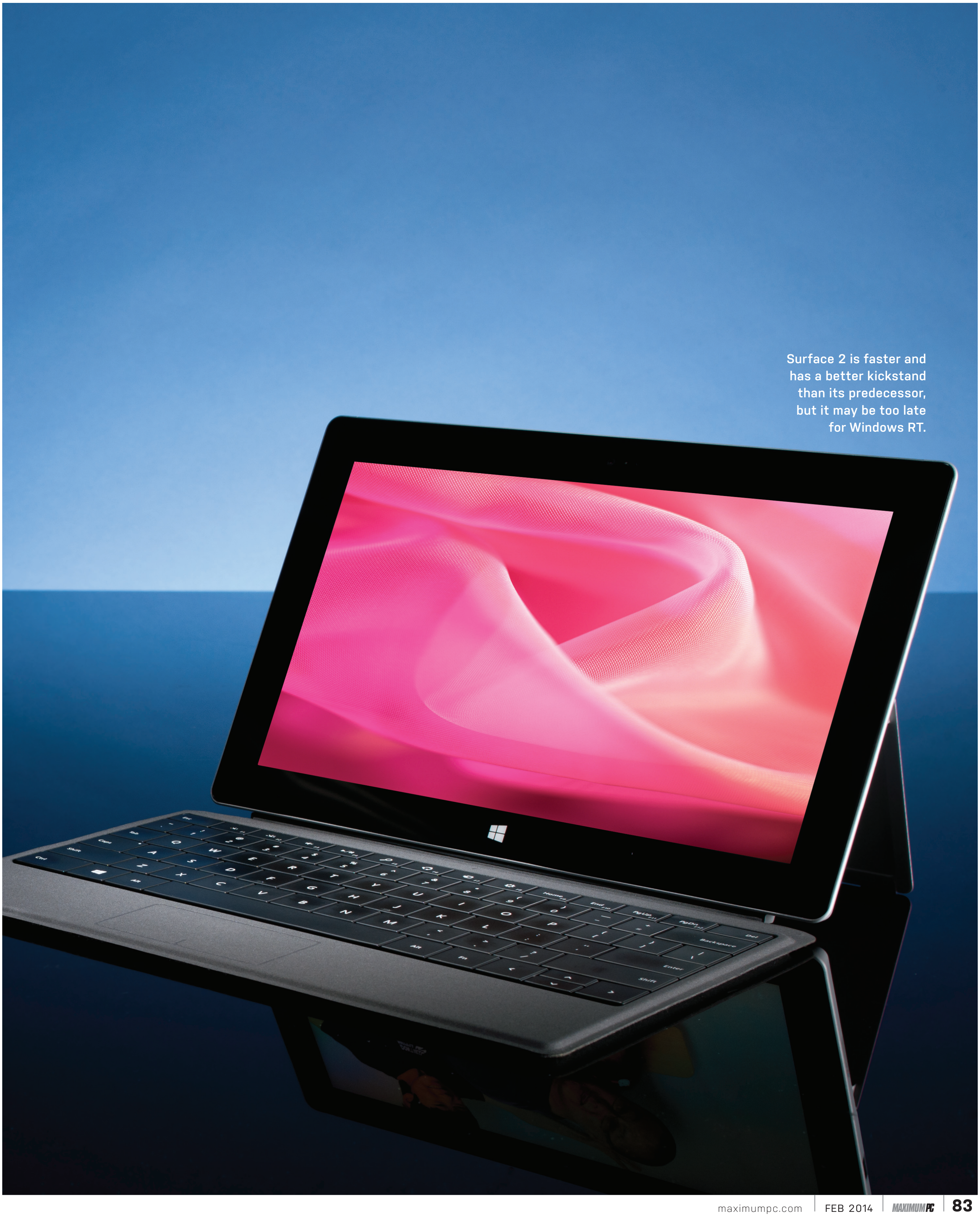
6

Microsoft Surface 2

➕ **EMPIRE STRIKES BACK** Includes Office 2013; TypeCover 2 keyboard is actually usable.

➖ **GHOSTBUSTERS II** Weak app store; keyboard not included; disappointing battery life.

$580 (32MB w/TypeCover 2 keyboard), www.microsoft.com



Surface 2 is faster and has a better kickstand than its predecessor, but it may be too late for Windows RT.

Think of the Source 530 as a more sedate Phantom 530.

NZXT Source 530

Simple, easy, spacious, and warm

IT'S UNDERSTANDABLE that NZXT left a few bucks off the price of its Source 530 case, as this full-tower chassis is really more a midrange offering than something you'll be taking out a second mortgage for. We're big fans of that, especially since the case's interior contains all of the usual NXZT-esque features that have graced many of company's previous cases we've reviewed.

Beyond the side-panel screws, which were a real beast to remove, installing a system inside of this decently roomy chassis couldn't be much easier. Motherboard standoffs on the Source 530 come pre-installed on the tray (yes!), an ample cutout exists behind the CPU cooler for any aftermarket fiddling you might want to do, and there's just about an inch of space between the tray's rear and the (other) side of the case for cable management.

Storage-wise, the Source 530 uses drive trays to give you a speedy installation path for up to six 3.5-inch drives at once. They're split into three separate cages that fit one, two, and three drives each, which you can remove from the case in an effort to "improve" airflow within your chassis. Why quotes? We'll get to that in a moment.

The three bays for optical drives (or fancier fun, like all the ample water-cooling this case can support) use built-in locking mechanisms to hold your components in place; the more timid among you can also use two screws to secure each device from the other side. A single 2.5-inch drive mount sits behind the motherboard tray for any SSDs you want to stuff vertically. Additional 2.5-inch drives can be mounted into the 3.5 trays, too.

Installing add-in cards in the case is your typical, mildly annoying affair—thumbscrews hold the covers in place and you'll likely need (or want) a screwdriver to take them off. The motherboard tray itself has six major cable-routing holes drilled into it, which do a great job of assisting you when you go to string wires every which way. Our standard test build for cases—which includes the use of an Nvidia GTX 480 video card—left us with plenty of room to maneuver and hide our cables around the chassis (thanks to said holes).

Here's where it gets troublesome, however. The case comes with two fans pre-installed. However, NZXT slaps a 12cm fan at the rear of the case's inside, and a 12cm fan on the rear-top—both exhaust. We'd prefer to have a dedicated intake fan for stronger cooling, and we're slightly worried that the HDDs won't get adequate cooling (though NZXT does give you the option to use your own 12-, 14-, or 20cm fan). Yes, we know there's research to indicate that, despite popular belief, drive temps don't really impact life span, but we get uncomfortable without some air moving over our HDDs, especially in the stifling-hot summers.

Rounding out this chassis are two USB 3.0 ports on its front, and a button that controls a lovely, SATA-powered LED light on its rear. Quaint touches for an otherwise roomy, easy-to-use, sub-$100 full-tower chassis. Still, you can pack quite a party in NZXT's chassis; what it lacks in bells and whistles, it makes up for in raw simplicity. –**DAVID MURPHY**

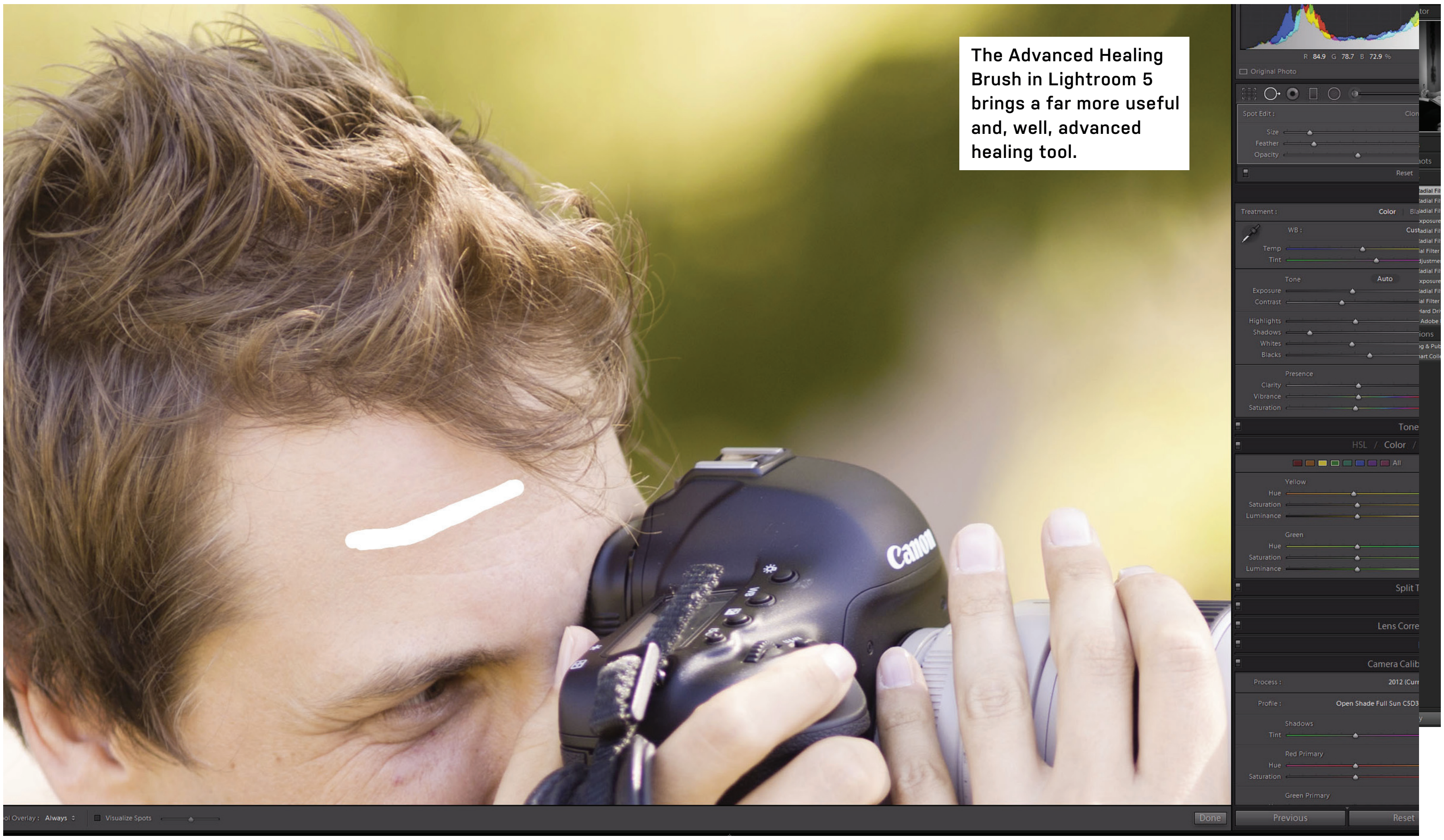
VERDICT **8**

NZXT Source 530

➕ **SOURCE ENGINE** Easy installation; ample space for drives, water cooling, and fans; great cable management; handy LED light on rear.

➖ **SOURCE CODE (THE MOVIE)** Poor cooling; no fancy adornments.

$90, www.nzxt.com



The Advanced Healing Brush in Lightroom 5 brings a far more useful and, well, advanced healing tool.

Adobe Photoshop Lightroom 5

Latest update polishes an already valuable tool

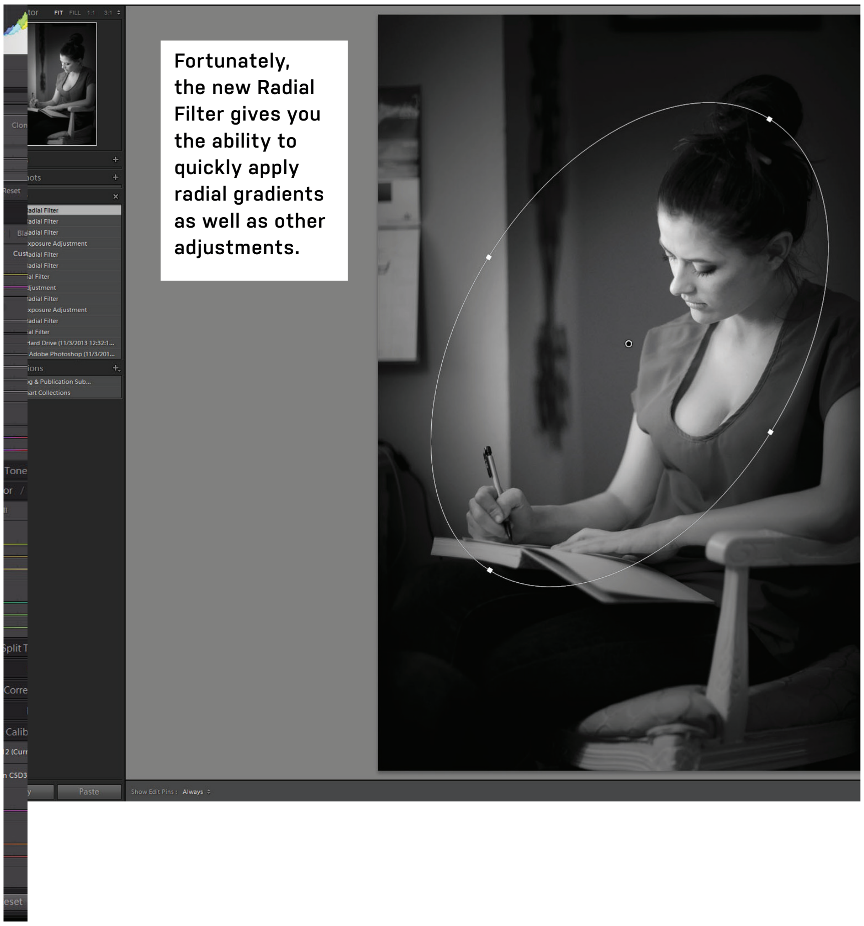
ADOBE PHOTOSHOP Lightroom 5 is yet another evolution in the life of this impressive and increasingly capable raw photo processing and digital asset management (DAM) application. If you're not familiar with Lightroom and you're a photographer, you've either been living under a rock or you just got your very first camera kit. Regardless, here's a quick refresher. Lightroom combines two major modules, along with five additional peripheral modules, all designed to simplify the process of managing and processing the large intake of photographs people take today.

Lightroom is not a replacement for Photoshop, but rather a companion. In fact, Lightroom is so robust, we find that Photoshop is relegated to very specific tasks and 95 percent of our work can be done in Lightroom alone. Photoshop only becomes necessary for things like stitching panoramas, doing highly customized image sharpening, or very sophisticated image patching or object removal.

Don't confuse Lightroom with Adobe Bridge (the company's media asset manager), either. Superficially, there is some overlap in their functionality, but don't fall into the trap of thinking that Bridge is "good enough." We've encountered photographers who initially believed that learning Lightroom would be a waste of time because "Bridge does everything Lightroom does." In every case, these same photographers end up regretting that they didn't transition to Lightroom sooner.

So, what's new over version 4? For us, the big changes are the Smart Preview system, the enhanced Spot Removal Tool, and the Radial Filter Tool. If you're a landscape or travel photographer who embeds GPS data in your images, you'll love the new Map module, which shows your images overlaid on a map. If you often find yourself tweaking perspective in the lens corrections module, you might love the new Upright feature, which automates major perspective corrections. If you do video side-by-side with your still photography, you can now mix video and stills into Lightroom-generated slideshows. All of these improvements plus much more mean there's something for everyone.

The Smart Preview system enables full raw edit-ability in a very lightweight package. We find ourselves wanting to take our work on the road, but taking the tens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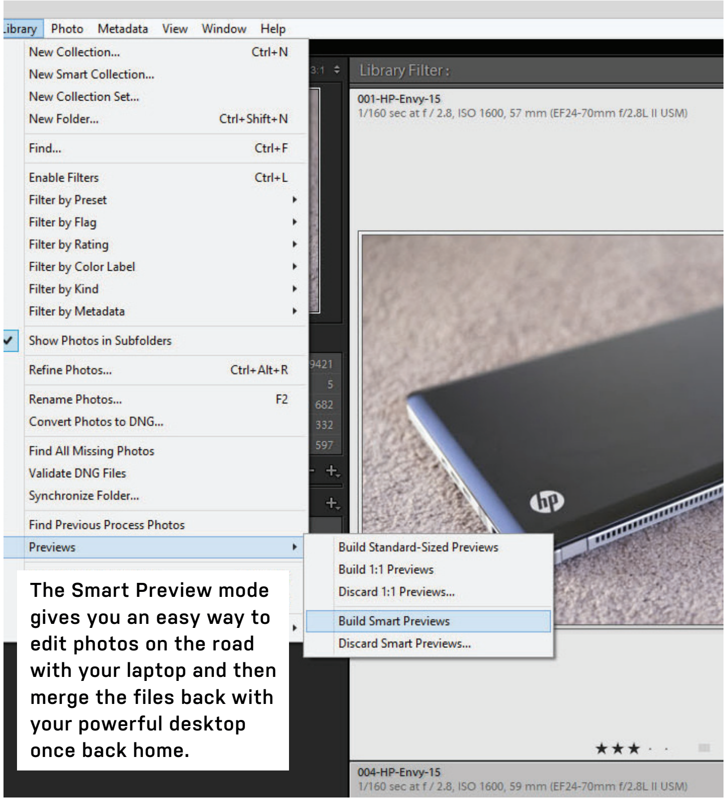
Fortunately, the new Radial Filter gives you the ability to quickly apply radial gradients as well as other adjustments.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Show Photos in Subfolders
Refine Photos... Ctrl+Alt+R
Rename Photos... F2
Convert Photos to DNG...
Find All Missing Photos
Validate DNG Files
Synchronize Folder...
Find Previous Process Photos
Previews
Build Standard-Sized Previews
Build 1:1 Previews
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Build Smart Previews
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Library Filter :
001-HP-Envy-15
1/160 sec at f / 2.8, ISO 1600, 57 mm (EF24-70mm f/2.8L II USM)
004-HP-Envy-15
1/160 sec at f / 2.8, ISO 1600, 59 mm (EF24-70mm f/2.8L II USM)

The Smart Preview mode gives you an easy way to edit photos on the road with your laptop and then merge the files back with your powerful desktop once back home.

or even hundreds of gigabytes associated with a large shoot can be daunting. Now with Lightroom 5, we can go to our master collection that's typically on our big desktop box, select the images we want to take on the road, then select File > Export As Catalogue. In the next screen, uncheck "export negative files," and check "build / include smart previews." Under the hood what happens next is that Lightroom exports a new catalog with lightweight, downsampled files based on Adobe's Lossy DNG tech. These files are tiny compared to your master raw files, but still maintain full raw edit-ability. If you outsource your raw processing to someone else, now you can realistically deliver jobs via Dropbox rather than shipping a hard drive. When you're finished working on the road, simply re-import the export catalog to your master catalog, and Lightroom seamlessly integrates all your changes into the master raw file.

The enhanced Spot Removal Tool is improved in three ways. First, you have control over edge feathering. Second, you can control the opacity of the removed spot, meaning it's now capable of doing more natural skin and blemish removal. Third (and this is the big one), you can now paint non-circular removal areas. In LR4, all you could do was click to create a circular spot removal. Now on LR5, if you click and drag you begin painting a mask of any size and shape you desire.

The new Radial Filter Tool is marketed by Adobe as a vignette tool with more control, which is true, but we feel this undersells how useful it is. All the controls you associate with the Graduated Filter tool can now be applied in a radial fashion, as well. This means new ways to quickly correct entire areas surrounding your subject.

Unlike most of Adobe's other apps, Lightroom 5 continues to offer a standalone license, which means you "own" it once you've bought it rather than paying every month in perpetuity for it. Adobe does offer a "cloud" version, which is bundled with Photoshop Creative Cloud for $40 a month. By itself, Lightroom 5 is $140 new or $80 as an upgrade.

All of this doesn't mean Lightroom is perfect. We've previously criticized the underlying code and task scheduling for being sluggish, not taking full advantage of the computing hardware, and not scaling well on faster hardware. Unfortunately, Lightroom 5 doesn't offer any change here, but it should. Performance isn't horrible but we'd love to see a lightning-fast preview mode that takes advantage of a raw file's built-in preview data, à la Camera Bits's PhotoMechanic, to make culling large volumes of images faster.

Ultimately, though, just because a tool is the best choice doesn't mean it's flawless. If you're a hobbyist or professional photographer, Lightroom deserves to be your tool of choice. In spite of its weaknesses, Lightroom 5 offers enough new utility to be a worthy upgrade or outright purchase for anyone who needs help dealing with large amounts of images. **–GAVIN FARRINGTON**

VERDICT 8

Adobe Photoshop Lightroom 5

+ BOKEH Still non-cloud version; Smart Preview mode lets you easily bring your work on the road.

− CHROMATIC ABERRATION Needs optimization for more modern hardware.

$150 new ($80 upgrade), www.adobe.com

It wouldn't be an Assassin's Creed game without the requisite "talk to the guy you're about to kill" cutscenes.

Assassin's Creed IV: Black Flag

How much rum can one possibly plunder?

IF YOU'LL ALLOW this prospective pirate to get personal for a moment, we really didn't want to like Assassin's Creed IV: Black Flag. Having spent far, far too long killing this and that in the ol' Animus throughout the five previous major titles in the six-year franchise, we're starting to get the feeling that Assassin's Creed is borrowing a page from the Call of Duty franchise—it refuses to just up and die.

Back out from the game's minutia, and there's nothing wrong with Black Flag's overall concept. You're an assassin sort of tasked with dispatching a number of antagonists, collecting a crap-ton of hidden items, and running the equivalent of eight ultra-marathons per gaming session as you traverse the various historical landscapes while donning the stereotypical assassin "hoodie outfit."

Since it's Assassin's Creed—and since the developers, we suspect, always want to add some sort of additional gravitas beyond one's pincushion-prone adventures—there's a side component of Black Flag that functions as the game's main quest. Yes, you read that right.

The entire plot is an *Inception*-like romp into one's ancestral consciousness, and your "real-world" persona in Black Flag is a not-so-impressive, unnamed employee at the fictitious gaming firm Abstergo Entertainment. To us, the infrequent warping between the game's two environments is the series' seventh-inning stretch: You have to slowly stand and sing the familiar tune, even if you don't want to do it. You have no way out.

Thankfully, Black Flag balances out its real-world boredom with the series' most refined and engaging mix of quasi-open-world gameplay to date, set in a gorgeous environment that makes us yearn for a 15-minute trip on a watery Disney ride. If nothing else, we commend developer Ubisoft Montreal for finally understanding that pirates are way cooler than the American Revolution (Blackbeard: 1; Benjamin Franklin: 0). This simple hook alone should be enough to wet the whistles of many a gamer who has felt otherwise let down by any pirate-themed game that doesn't start with the word Monkey.

Our problem? It takes too long to get there. Tutorials are tutorials, but Black Flag is one of the first games in the franchise—at least, that we can remember—that had us scratching our heads a bit as to how everything works. It's partially the fault of the game's early missions, which do a decent, but not-so-perfect job of detailing everything that your character (or ship) can do. Case in point: We had to look up how to fire our ship's heavy shot. One of the most powerful weapons in one's watery arsenal... and we had to Google it.

Wrapped within that is the odd combination of the game's painfully slow progression and quasi-open-world motif. We dislike how Black Flag presents a giant, explorable world, but locks much of it behind strange, shimmering, digital curtains until you progress to certain points in the game's main quest. The same holds true for all of your weapons and ship upgrades; you don't even get the tried-and-true staple of the series, the trusty hidden blade, until after the game dumps you into the wide-open world for a bit of time.

We get it; Ubisoft really wants you to play the Animus-based plot. Here's the problem with that: It's not that interesting. The storyline, as we've noted, is a bit out there, and the primary missions don't offer up many challenges or much diversity. You're encouraged to be stealthy merely as a part of an overall achievement unlock. Otherwise, there's no real penalty for crossing your Jack Sparrow with your Rambo within missions, which are,

reach the jungle's exit
11473 R

Half the fun of Black Flag comes from exploring your way to new (and super-pretty) locations.

side activities
naval fort
fort defenses destroyed 2/4
assassin contract
reach your target's location
295 m
1712 R

Yes, the game sends watery tornados into your path. No, you do not want to be in their path.

themselves, getting fairly standard within the overall Assassin's Creed universe. We'd be perfectly OK to never have to spend minutes eavesdropping on someone ever again.

Curiously enough, there's no actual progression for your character skills—you start off as a fairly formidable assassin with the ability to kill just about anyone quite quickly. We might have preferred an RPG-like upgrade system whereby one's talents, purchasable or otherwise, were a bit more customizable or upgradable. It could also serve as an excellent tutorial for the myriad moves and techniques one's assassin can do. Any of the recent Batman games gives a good example of what we're referring to. Black Flag borrows a simplified crafting/upgrading system from Far Cry 3, but it's not really enough.

Black Flag, like previous titles in the series, focuses much on your ability to free run, climb, dodge, and stab your way through levels. It's still a bit clunky to do so—akin to driving a large truck in an obstacle course instead of a more dexterous motorcycle. We can forgive that, however, because Ubisoft has finally managed to create open-world aspects that are fun regardless of how repetitive they might feel.

Yes, the ship combat does become a bit rote after a while, but the game delivers a thrilling joy after you successfully survive a close battle against an enemy convoy by the skin of your teeth. We thought we'd get bored shooting and boarding ship after ship after ship; to our surprise, we didn't. We almost wish the game went one step further and gave you some additional ships to play around with—a convoy of your own that you could command in some kind of quasi-real-time-strategy-like fashion. As it stands, there's great fun in blasting and boarding. We smiled each and every time we rope-swung out to an enemy ship to deliver stabby surprises.

Sailing around the map bombarding ports, evading waterspouts (yes, waterspouts), and chasing down giant treasure fleets that your online friends can identify on your map for you—to name a few activities—is a thrill. You can even cycle through songs for your crew to sing while you're sailing (and unlock others by finding them within the game) and, should you find yourself running low on patience, make use of the many fast travel locations that Ubisoft litters throughout the game's landscape. The Legend of Zelda: The Wind Walker, this is not.

We're running low on space to cover all the side activities you can undertake in Black Flag, and it behooves us to touch on one of the game's super-eye-opening features: companion apps for both Android and iOS, which deliver some of the best cross-platform interaction we've yet seen in a PC game. We absolutely love that we can fire up our tablets, load a free app, and have a real-time feed of our character's progression on the world map, quick access to our mission statuses, and even a means for interacting with Black Flag's game-within-a-game "Kenway's Fleet" trading system.

That said, we sure wish we had some easy means of pulling our existing online friends into Uplay—either those from Steam, Facebook, or any of the other big social or gaming networks. It would certainly help the title's multiplayer efforts, which feel pretty similar, if not identical to, that which we've already seen in the series. It could also boost the single-player game a bit, given the curious (but engaging) social tie-ins that Ubisoft has built right into the core campaign. We love this blend of online and "offline" gameplay; give us more!

What we don't want more of, however, is bloat; Black Flag's title screen feels a bit clunky with its many advertisements and links to external websites. Tone those parts down a bit, Ubisoft, please.

As for the game, definitely play Black Flag, but we'd argue that it's more fun as a pirate romp than a full-fledged simulator of silent deaths. Far Cry 3 handled some of these stealthy, lone-gunman mechanics more interestingly; Assassin's Creed borrows a little bit from the best, but none can currently rival the fun it brings to the high seas.

–DAVID MURPHY

VERDICT
8

Assassin's Creed IV: Black Flag

⊞ **YO HO, YO HO** Lovely graphics; engaging naval exploration and combat; streamlined gameplay across a sprawling landscape; fun mobile tie-ins.

⊟ **A PIRATE'S LIFE FOR YOU** Boring "real-world" motif; slow unlocks; not all that challenging; Uplay is Upaltry.

$60, assassinscreed.ubi.com, ESRB: M

LAB NOTES

JOSH NOREM **SENIOR EDITOR**

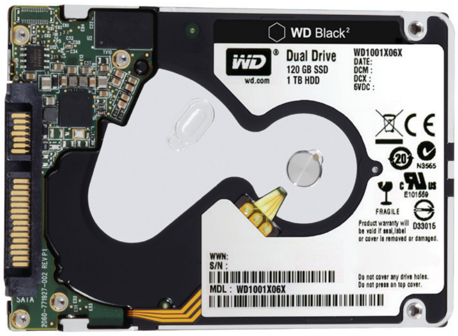
WD's New Black Squared Drive

Notebook speed junkies no longer have to choose between SSD and HDD

AS SOMEONE who covers the storage beat, I rarely get the chance to look at drives from WD, simply because the company's spinning drives don't change very often, and it doesn't offer consumer-based SSDs. Given that scenario, imagine my surprise this month when a package arrived from WD containing a single 2.5-inch drive that houses both a 120GB SSD and a 1TB HDD. Yes, two individual, separate drives in one enclosure, not a hybrid drive. Dubbed the WD Black Squared, it's a drive designed for people who have just one slot to fill for storage, and want the capacity of a hard drive and the speed of an SSD. This does not apply to desktop jockeys, obviously; but for people who are rocking a laptop, this dual-drive could be just what the drive doctor ordered.

It's a clever design in that it combines an ultra-slim two-platter 5,400rpm 1TB drive with a teeny piece of 20nm MLC NAND flash. WD told us the hard drive is new and exists in its Black family of "high-performance" drives. The SSD is 111GB after formatting and uses a Jmicron JMF667H controller—a controller we haven't seen in a long time, so we're puzzled by WD's choice. The two drives share a SATA 6Gb/s interface, and divide the allotted 600MB/s of bandwidth between them. For performance, WD says the SSD is good for 350MB/s read speeds and 140MB/s write speeds, and our own benchmarks back up this claim. CrystalDiskMark showed us read speeds of 411MB/s on the SSD and 114MB/s on the HDD, and write speeds of 146MB/s on the SSD and 114MB/s on the HDD. Overall, those are decent speeds, but neither the SSD nor the HDD are going to blow your mind with their performance.

Still, I'm sure it's fast enough for most folks. I think the only specification that will cause people to do a double-take is the price, because at $300 it's expensive. We'll find out if it's worth it in my full review next month.



The Black Squared is Windows-only for now. Sorry, Mac users.

JIMMY THANG

Online Managing Editor

The first iPhone is now six years old. What if I told you that all developers were forced to focus development on that specific SKU, even though newer, more powerful phones have come and gone in the years since? With the last-gen consoles being as old as the original iPhone, I've come to the realization that this is exactly what the closed nature of these old consoles are doing to the PC gaming space right now. With hardware advancing each and every day, the consoles' antiquated design is stunting technical innovation when it comes to graphics, AI, physics, and more. It's time for consoles to evolve and become more modular, or move out of the way.

Tom McNamara

Associate Editor

We work with several large monitors in the Lab so we can test resolutions above 1080p. But they range from 27 to 32 inches and can take up quite a bit of real estate. They're also heavy and awkward to move around. So, while I'm glad to see Dell coming out with a 24-inch 4K panel, I hope the industry doesn't just leapfrog smaller 1440p and 1600p displays. Your average desktop can't really accommodate more than one of the jumbo displays (nor can your wallet), which means you can't have multi-monitor workflow. Still, it's great to see Dell hitting super-high-res panels with a shrink ray, and with appropriately slashed prices, too.

First Look: Valve's Dual Trackpad Steam Controller

The Steam Controller features two trackpads that work amazingly well as a keyboard/mouse replacement

PC GAMERS, gods bless 'em, are truly the most cynical sons of bitches on the planet. We say this because when we saw Valve's attempt at a controller for its upcoming Steam Machines, we, like all other PC gamers, just snickered and ran as quickly as we could to a web-based meme generator in order to create and post something derisive and snarky. Alas, those cynical PC gamers had already beaten us to it.

The Steam Controller, as it's called, is a key element of Valve's plan to bring PC gaming to the living room, and we were highly skeptical of it. You see, there are some things that can't be done. For example, you can't make an *Aliens vs. Predator* movie and not have it be so horrible it isn't even worth watching for free on Netflix. You also can't make Almond Joy actually enjoyable, either.

It's with this attitude that we got to wrap our dry hands around a prototype of the Steam Controller. If you're looking at the still image of it, it's about the size of a standard console game controller but rather than a joystick, joy pad, or other thumb controllers, the Steam Controller features two circular trackpads that can also act as buttons. There's also a set of buttons on the bottom as well as the front of the unit.

To most people, the puzzling part is the two gigantic Pikachu-eyes trackpads. People just can't wrap their heads around the concept of how they could possibly work. Neither could we. For our preview of the Steam Controller, we first tried Borderlands 2—a popular first-person shooter. To move, we used our left thumb to simulate the usual WASD movement of forward, backward, and left and right. The right trackpad acted as free look on a mouse. There's a subtle feedback through the "dual linear resonant actuators" in the controllers—basically, super-precise haptic feedback.

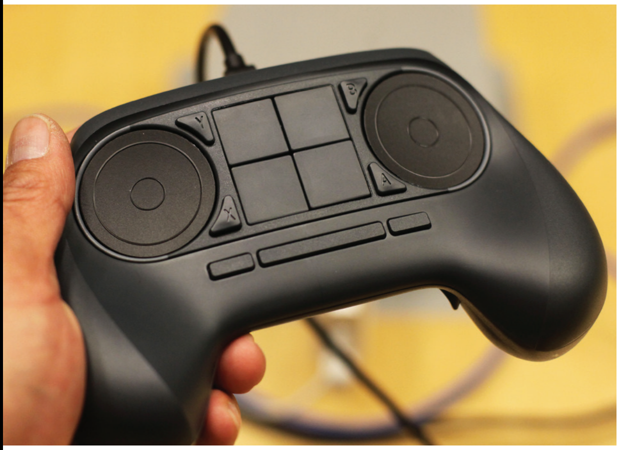
Valve plans for the shipping controllers to also feature a touch-sensitive high-resolution screen in the center of the controller, but the prototype unit features just four physical plastic buttons and is wired, too.

In game, the dual trackpads work surprisingly well. Again, we went into it expecting to be underwhelmed, thinking that Valve was tilting at windmills, but we were surprised. After a minute of adjustment we were running around the set of Borderlands 2, jumping off objects. It was as natural and as close as we've ever gotten to a keyboard/mouse experience—without a mouse and keyboard. One of the most important moves that we've never been able to do easily on a gamepad is circle-strafe; on the Steam Controller we found an object and easily executed that move. In fact, it was fun picking a target, circling, and shooting it without having to try to rewire our mind the way we have to with a typical game-console controller.

Not everything worked for us, though. Our brain couldn't work with it in RTS mode where both trackpads let you scroll around quickly. Perhaps it's how it was mapped. Valve says it expects to let users actually create and publish profiles that map the controls for specific games.

Don't be fooled: This is not and cannot be a 100 percent replacement for a good mouse and keyboard, which still reigns supreme for control; but for a console controller, it's surprisingly good.

When can you try one? Probably not until the middle of this year when they're expected to be released along with Valve's Steam Machines. **–GU**



The Steam Controller features two trackpads that work amazingly well as a keyboard/mouse replacement.

GEEK TESTED & DISAPPROVED

TomTom Multi-Sport GPS Watch

TomTom
8.4
23:56
2.85
distance

Lately, TomTom has been expanding from pure navigational devices, releasing its Multi-Sport GPS Watch that's designed to be a one-stop speed/distance monitoring solution for swimmers, runners, and bikers. The watch has a large scratch-proof screen similar in size to Samsung's Galaxy Gear (about 1.5 inches square), and has a square D-pad that allows you to easily swipe up, down, left, and right to navigate between the different modes and to adjust settings. It all works easily enough. The display comes housed in a rubberized wrist strap and the entire package feels rugged yet light and comfortable. Aesthetically, it looks geeky, but in a cool way.

The device does have problems, though. While the outdoor running and biking modes, which rely on GPS, work well, pool and treadmill workouts, which rely on arm swings, are inaccurate and simply don't work half the time. This could potentially be fixed with a firmware update, but for now we can't confidently recommend it. $200, www.tomtom.com **–JT**

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THE BUILDS

BASELINE

PERFORMANCE

INGREDIENTS

PART			PRICE
Case	Corsair Vengeance C70		$108
PSU	NZXT HALE82 750W	**NEW**	$99
Mobo	Gigabyte GA-Z87X-UD3H		$150
CPU	Intel Core i5-4670K		$220
Cooler	Cooler Master Hyper 212 Evo		$35
GPU	EVGA GeForce GTX 760 02G-P4-2763-KR	**NEW**	$250
RAM	2x 4GB G.Skill Ripjaws F3-12800CL9D-8GBXL	**NEW**	$53
Optical Drive	LG GH24NS95		$15
SSD	Crucial M500 240GB	**NEW**	$140
HDD	Seagate Barracuda 1TB		$60
OS	Windows 8 64-bit OEM		$100

Approximate Price: $1,230

INGREDIENTS

PART			PRICE
Case	NZXT Phantom 530		$130
PSU	Seasonic M12II 850W		$121
Mobo	Asus Sabertooth X79		$315
CPU	Intel Core i7-4820K		$320
Cooler	Corsair H80i		$80
GPU	EVGA GeForce GTX 780 Ti		$700
RAM	4x 4GB G.Skill Ripjaws DDR3/1600	**NEW**	$140
Optical Drive	Asus BW-12B1ST		$60
SSD	Samsung 840 Evo 500GB		$330
HDD	Seagate Barracuda 3TB		$109
OS	Windows 8 64-bit OEM		$100

Approximate Price: $2,405

THE BASELINE build is what we consider the minimum for enthusiast-level performance. Some items from last month are no longer on sale, such as the 720W Cooler Master Silent Pro power supply, so we've replaced it with the NZXT Hale82 750W power supply, which is built by Seasonic. The Corsair C70 case has gone up $18, but we think it's still a great case for the money, so we're keeping it. The Radeon HD 7950 we were using is discontinued, and AMD doesn't have a directly comparable card in its new lineup, so we turned to Nvidia and added the similarly performing EVGA GeForce GTX 760. We also switched SSDs, as the Crucial M500 is $40 less than the Intel 530 we were using, while offering roughly the same performance.

NOT MUCH HAS changed from last month, though we did switch from the Ares flavor of G.Skill RAM to the Ripjaws due to price fluctuations. On the GPU front, we considered swapping out the GTX 780 Ti for an AMD Radeon R9 290X, but then we discovered they are extremely hard to find, and the ones we could find were priced way above the MSRP of $550. Apparently, the Bitcoin gold rush has a lot of entrepreneurs buying AMD cards because they are good at generating a few specific types of crypto-currencies. On the SSD front, the Samsung 840 Evo remains the top dog of the second-tier SSDs, and delivers exceptional performance thanks to its caching ability (which has recently been enabled for the pricier 840 Pro as well).

ULTRA

YOU MIGHT wonder why a system referred to as Ultra doesn't have a custom water-cooling loop, 64GB of RAM, multiple hard drives in a RAID setup, and so on. The answer is, we like to think of it as more of a starting point than a definitive system. Once you get into this kind of budget, different builders will want to go in different directions, but we're providing the baseline "blueprint" for the Ultra rig.

This month, the only notable addition is the return of NZXT's Kraken X60 closed-loop liquid CPU cooler, as it replaces the Corsair Hydro H100i. The X60 uses a 280mm radiator and two 140mm fans, so it has a larger surface area to dissipate heat, and its fans operate a bit more quietly. We also find the Kraken software easier to use, and its data is easier to parse. We've also upgraded our GeForce GTX 780 GPUs to the faster "Ti" version. We'd like to upgrade the Samsung 840 Evo to the Pro version, but there was no 1TB version as we went to press.

INGREDIENTS

PART			PRICE
Case	Corsair Obsidian 900D		$310
PSU	XFX ProSeries 1,250W P1-1250-BEFX		$270
Mobo	Asus X79 Deluxe		$349
CPU	Intel Core i7-4930K		$580
Cooler	NZXT Kraken X60	**NEW**	$118
GPU	2x EVGA GeForce GTX 780 Ti	**NEW**	$1,400
RAM	4x 4GB G.Skill Ripjaws DDR3/1600	**NEW**	$140
Optical Drive	Asus BW-12B1ST		$60
SSD	Samsung 840 Evo 1TB		$530
HDD	Seagate 4TB Desktop HDD		$160
OS	Windows 8 64-bit OEM		$100

Approximate Price: $ 4,017

For more of our component recommendations,
visit www.maximumpc.com/best-of-the-best.

UPGRADE OF THE MONTH

SILVERSTONE CP11 DATA CABLE

E214134 30AWG

These super-low-profile SATA cables are handy for building in a mini-ITX case, especially if your motherboard's SATA ports aren't 90 degrees and end up getting blocked by the video card. The downside is that the cables are only 11 inches, so they won't be of much use in an ATX or larger rig.

$10, www.silverstonetek.com

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